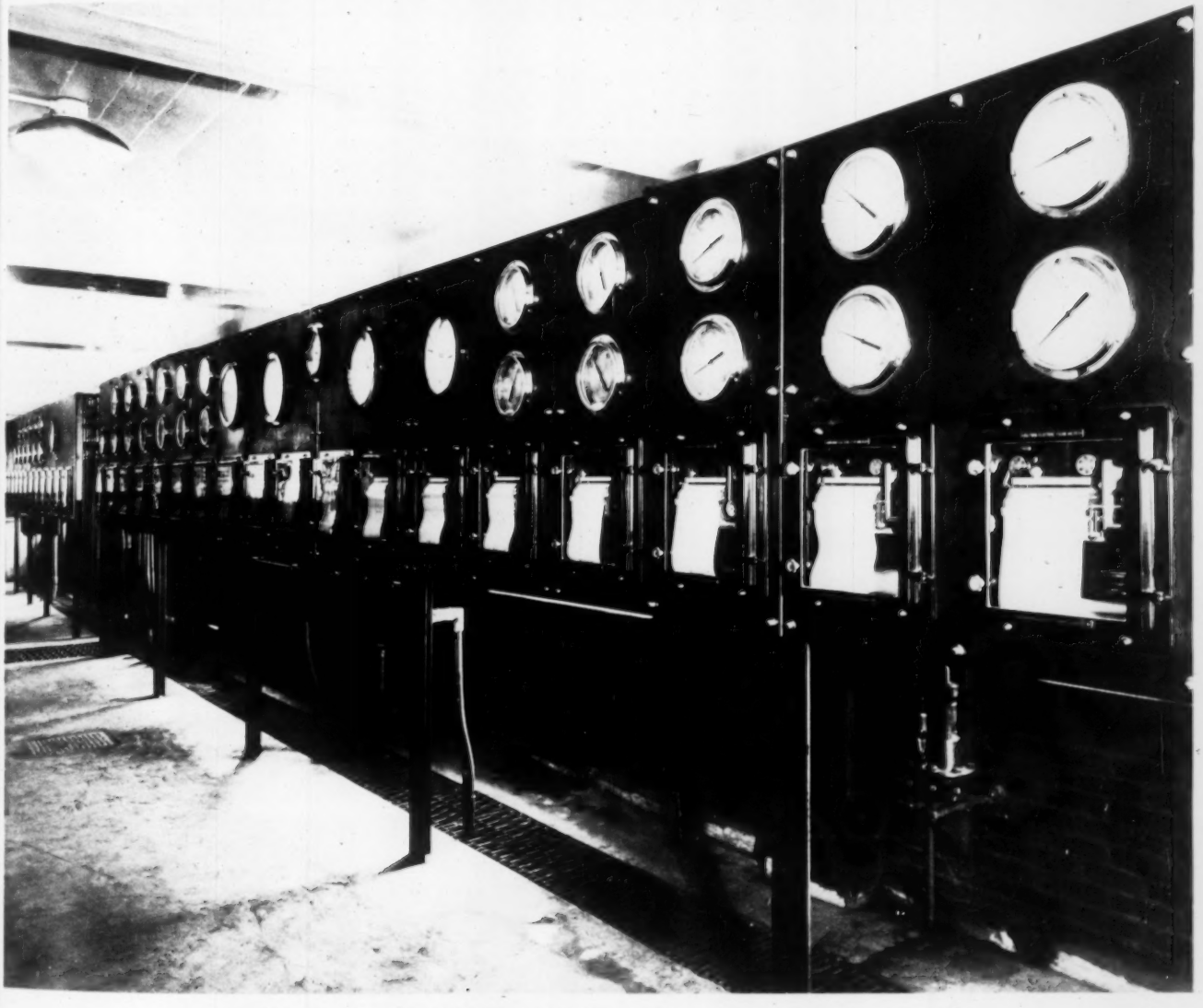
INSTRUMENTS

THE MAGAZINE OF MEASUREMENT AND CONTROL

VOLUME 5 AUGUST, 1932 NUMBER 8



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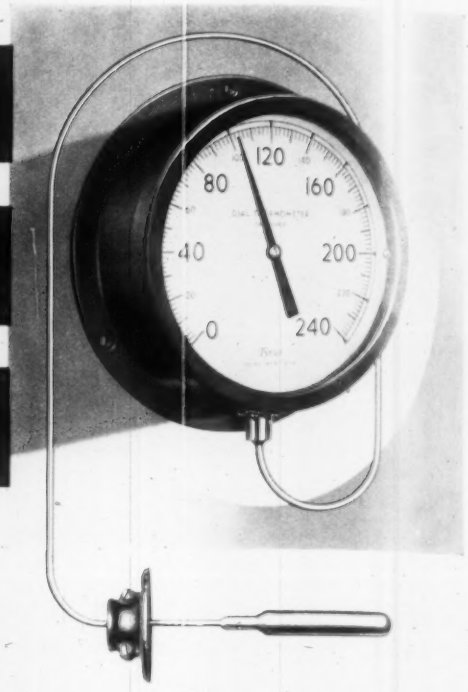
SEE INSIDE BACK COVER

A New Tycos Indicating
Dial Thermometers



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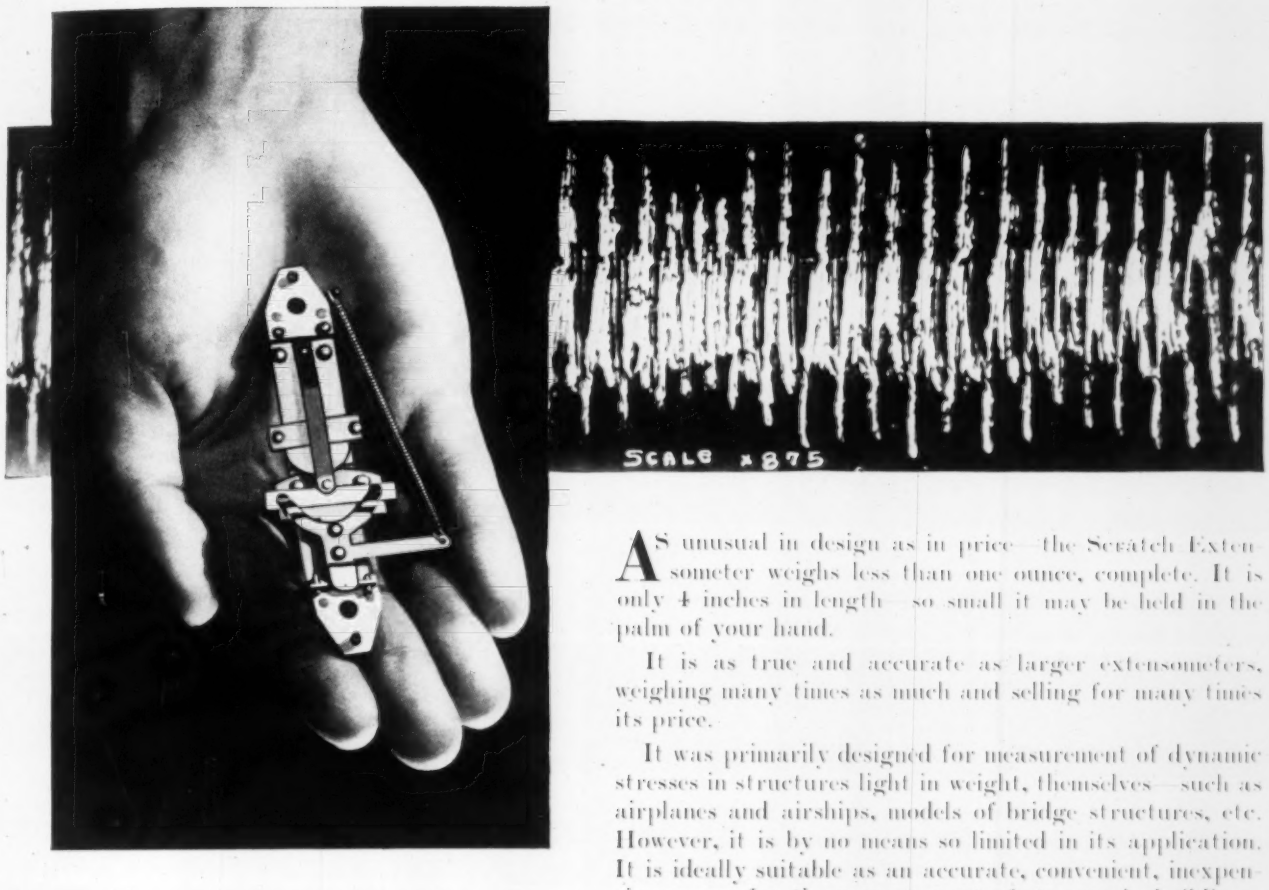

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INSTRUMENTS

THE MAGAZINE of MEASUREMENT and CONTROL

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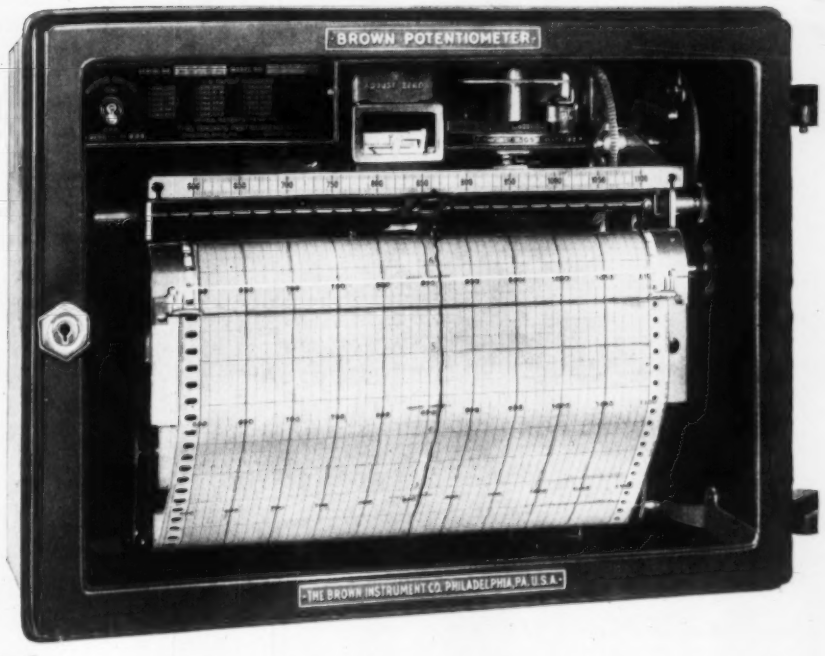
TREND-ANALYZING CONTROL



Actual chart record of Trend Analizing Control using Brown Potentiometer Pyrometer.

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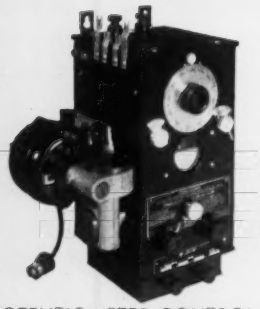

POTENTIOMETER CONTROL PYROMETER
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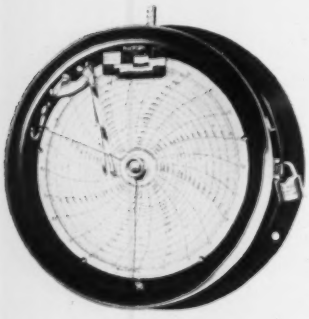

"ROTAX" ELECTRICAL CONTROLLER
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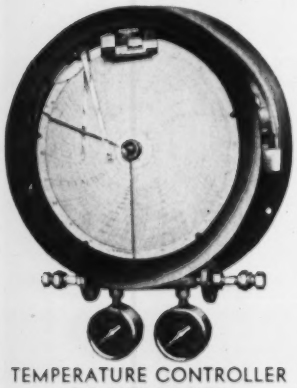

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EDITORIAL COMMENT

In This Issue

◆ Not only gas companies, but all industrial plants using large numbers of instruments, will find useful hints on the questions of maintenance, checking and replacements in the first article. Though Mr. **Johnston** deals only with **Small Gas Regulators**, his conclusions are applicable to many other devices.

◆ Entirely devoted to magnifying gears is the current instalment of Prof. **DeJuhasz's** book. These important elements of **The Engine Indicator** are analyzed with a profusion of details and interesting comments.

◆ And in the current instalment of his book on **Flow Measurement and Control**, **Major Béhar** again breaks new ground, with a novel but evidently logical analysis of "head meter" indicating instruments.

◆ **Forty-Eight Articles on New Instruments** then follow. What a treat for readers who make it a practice to look through this department regularly! And what reader, we ask, ever relaxes his constant search for improved devices? By the way, this department usually includes items announcing not only how to do something better, but how to do something that couldn't be done before.

◆ ◆ ◆

The Front Cover

◆ The front cover shows several instrument boards at the **Continental Oil Company.**

Well Meant But Fallacious

AN eminent technical journal editor whom, on this page last autumn, we took delight in complimenting, devotes his July editorial to giving advice to unemployed radio engineers. We quote:

> . . . Scattered all over the country today are unemployed radio engineers, familiar with the principles of these electronic devices. These engineers can find plenty of opportunity for their own ingenuity if they will drop into local shops and factories in their vicinity (particularly "home-town people" they know), and ask to be taken through the shop or plant to suggest opportunities for saving money. Practical uses will at once suggest themselves, and the engineer can arrange to install the electronic apparatus and get it working . . .

Our first impulse was to print this excerpt here with no other comment than the title **For Instance?** Mature consideration, however, shows the need of a conclusive refutation.

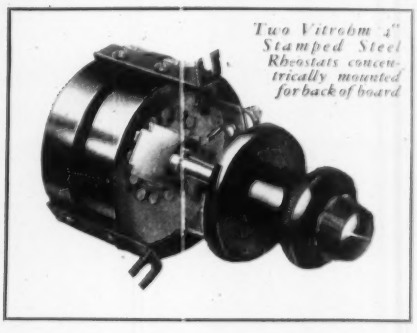
To engineers who know the difficulties involved in specifying the proper equipment for each application in an industrial plant, we need not point out that the quoted advice rests upon an untenable premise. Experience has taught them that the trained sales engineer familiar with *their* problems is a help, while the outsider "nosing around" trying to sell auxiliary devices for applications which he has not carefully studied in advance is a nuisance.

Exemplifying the former is the application engineer traveling for an instrument firm which has thoroughly trained him in the processes of the industries he is to call on. He knows the many details of the applications—in fact he often suggests improvements unrelated to the devices he sells. Therefore, he generally is a welcome consultant.

Exemplifying the latter is the *average* so-called radio "engineer" (we mean one who is not an engineering graduate). And for four reasons: (1) He is seldom familiar with processing equipment. Give him a pass to the plant, lead him in front of a continuous normalizing furnace, multiple-effect evaporator, dephlegmator tower or specialized vulcanizer, and nine times out of ten he will know neither what it is nor what it is for. (2) Even if he can name each piece of equipment in the plant and state its purpose, the chances are a thousand to one that he (or any *unprepared* outsider) will not be familiar enough with the process itself to recommend changes. (3) Nearly every unsold possible application for an electronic device is an unsold application for a non-electronic device. Regardless of which would be the better device, the unsold application is likely to be an *untried* application for an electronic device and at the same time one for which non-electronic devices have been tried and approved. (4) Few radio engineers know enough about electronic devices to "drop into factories" and "suggest opportunities for saving money." Granted that they know the characteristic curves of every vacuum tube and photocell on the market, what can they know, without special training in the fundamentals of instrumentation, of the *performance* characteristics of control devices in which these tubes are employed? Do unemployed compressed air engineers "drop into factories" where "practical uses will at once suggest themselves" for temperature and pressure controllers of the air relay type? Do unemployed clockmakers visit plants to suggest installing recorders, cycle controllers and other devices utilizing clocks? Do unemployed mercury refiners go around recommending thermometers and other mercurial applications?

Countless opportunities await electronic devices in industry. Nobody is more genuinely enthusiastic on this subject than the editors of INSTRUMENTS. But intemperate, injudicious enthusiasm—displaying itself in fatuous advice to unemployed radio engineers in general—can do no good and much harm.

There's a *trick* in handling heat



Two Vitrohm 4" Stamped Steel Rheostats concentrically mounted for back of board

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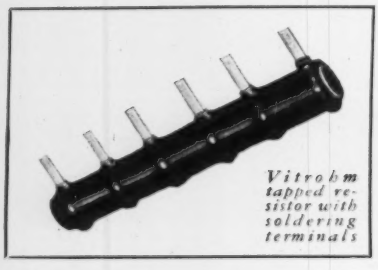

Vitrohm tapped resistor with soldering terminals

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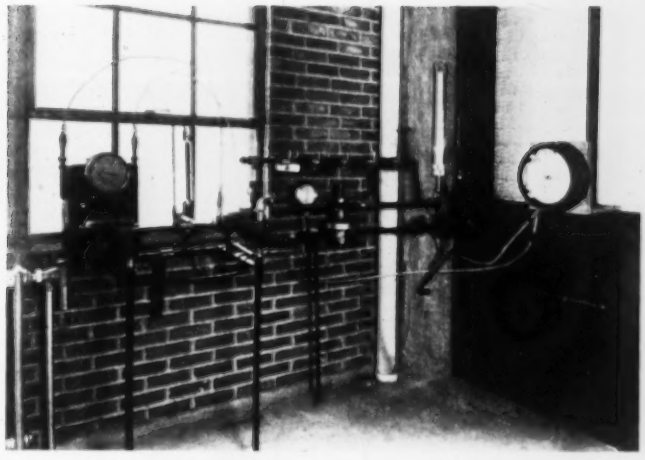
Small Gas Regulators and Unaccounted for Gas

By A. W. JOHNSTON, Jr.*



Governor Test Equipment

INTRODUCTION

IN JUNE 1927, a general survey of the Harrisburg Gas Company system was undertaken in an effort to reduce the amount of unaccounted for gas, which then was about 13% of the send-out. The company has approximately 33,000 meters, of which, 11,500 are supplied through house governors. Included in the survey was a systematic house-to-house inspection of governors. It is the intention of this paper to point out certain facts brought out by the investigation to date.

GOVERNORS AND GAS LOSSES

The existing conditions were found to be as follows: Prior to 1930, the number of blowing governors per year averaged 27%. In 1930 this increased to 38% and drew attention to the abnormal condition. A preliminary investigation showed that eight different makes of governors were in use. Shop tests revealed that of the eight, five possessed unfavorable operating characteristics, were badly worn from long use, or were obsolete. All adjustments and minor repairs at the time were being made on the customers' premises, with the exception of the non-replaceable type valve governors, which were removed and repaired in the shop. This latter type included about 36% of the total number blowing.

These conditions, coupled with the fact that unaccounted for gas had risen to 12.12%, under otherwise normal operations, made it appear plausible that the two were related, and that the increase in unaccounted for gas might be traced to the action of the governors. With this in mind, the procedure in governor handling was revised as follows:

The obsolete types were to be condemned and replaced by governors of modern design.

All governors found blowing were to be removed and a tag affixed, bearing the address of removal. No adjustments or repairs were to be made on customers' premises.

Out-going governors were to be overhauled and tested in the shop, through a consumption range varying from a pilot light to 150 cu. ft. per hour, and adjusted for a delivery pressure of 4 inches, at a consumption of 150 cu. ft. /hr. In no case was the lock-up or no-flow pressure to exceed 6 inches. Sealing pressure was to be 12 inches.

Each governor so tested was to be given a serial or company number, and an additional metal tag, showing the date and nature of the last repair.

Record of each incoming governor was to be maintained by the governor repairman. This record was to contain information such as serial number, date repaired, make, type, nature of repair, delivery and lock-up pressures, the date last repaired and the address from which the governor was removed.

Orders covering blowing were to be maintained in a separate file, so that periodic analyses could be made.

Racks were to be constructed for motor vehicles transporting governors, to insure proper handling.

*Meter department, The Harrisburg Gas Company.

RESULTS OF GOVERNOR SERVICING PROGRAM

After one year's operation under the revised procedure, the number of blowing governors decreased 38.3% despite the fact that only 2,740, or 23.6% of the total number of governors in service had been replaced by improved shop-tested types.

Accompanying this decrease, a similar reduction in unaccounted for gas, which in April, 1931, was 11.74%, compared with 8.04% in March, 1932, made it evident that some relation existed between the two. The similarity between the unaccounted for gas curve and that of blowing governors during the two years, is shown on the accompanying graphs. The saving brought about by the former is estimated to be 65,000 .mcf. (million cubic feet), and involves an amount of $19,500, to which must be added $1,500, the saving due to the reduced number of governors serviced.

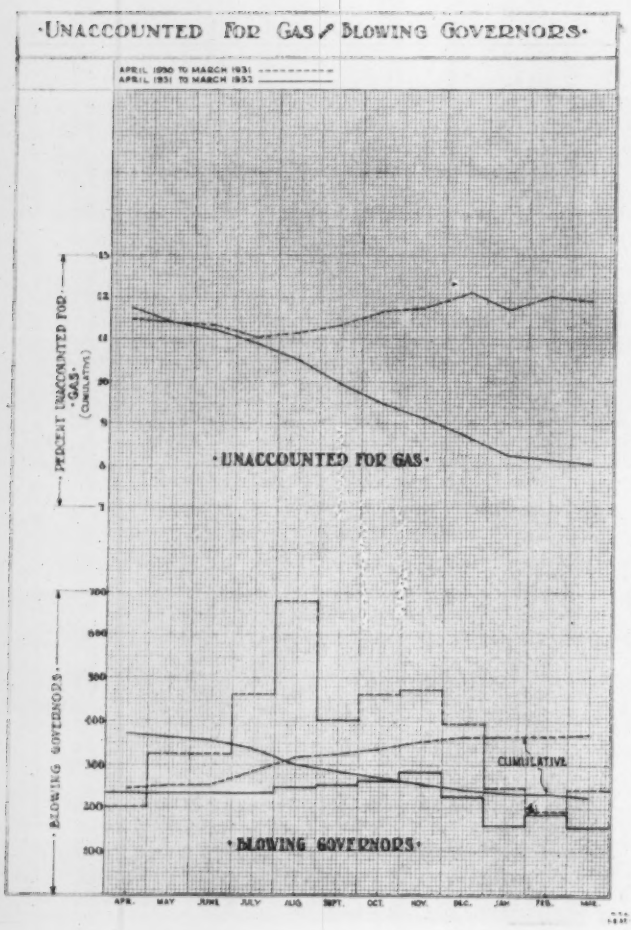
In 1930 repeat orders were responsible for 24.8% of the total blows, and, therefore, 9.6% of the 38.6% blowing rate. During 1931 this figure was reduced to 1%, but because of the fact that adjustments were no longer made on customers' premises, it is included with the other factors making up the total rate. It is evident, however, that the decreased 1,092 blows can be attributed to shop adjustment and repair in lieu of repair on the customers' premises, and *proves conclusively that replacement is more satisfactory than adjustment on the premises*, unless governor operation is thoroughly understood by service men and closely supervised. This fact appears somewhat contradictory to modern governor design which, in most cases, stresses the advantages of repair in position.

In replacing 2,740 poorly operating and obsolete governors with those of more recent design, the blowing rate of the governors, excluding that attributed to adjustment on the premises, was reduced from 29.0% to 23.4%.

BLOWING ELIMINATION

1. Dust

The blowing caused by the movement and accumulation of dust from main systems on governor valve disks is estimated at 5.7% of the blowing rate. This is equivalent to 660 blowing governors annually, the repair cost of which is $1,325. If we assume a 10% blowing rate for the newer type governors, 5.7% of which is due to dust, it follows that the inherent blowing rate of the governor itself is 4.3%, and the length of service of that governor almost indefinite. Careful observation has shown that dust movement is an important factor, and is particularly noticeable in the change period from one season to another, varying with decrease or increase in load. This condition becomes most exaggerated during


·UNACCOUNTED FOR GAS / BLOWING GOVERNORS·
APRIL 1930 TO MARCH 1931
APRIL 1931 TO MARCH 1932
PERCENT UNACCOUNTED FOR GAS (CUMULATIVE)
·UNACCOUNTED FOR GAS·
BLOWING GOVERNORS
CUMULATIVE
·BLOWING GOVERNORS·
APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR.

the months of September, October and November, and to a lesser degree during April, May and June, in this property. Elimination of blowing due to dust, whether accomplished by re-design of the valve, the seat, through some method of filtration, or by partial hydration of the gas, would materially assist in lengthening the service life of governors.

2. Valve Design and Construction

Following a year's observation and test on different make governors in and out of service, it is found that blowing, with few exceptions, is confined to the action of the valve and valve seat, or the inherent sensitivity of the governor. Of major importance is the action of the valve and seat. While practically all of the modern make house governors will, upon comparative bench tests, show about the same characteristics as far as delivery and lock-up pressures are concerned, little is known of their operation after extended periods in service. This paper points out interesting facts along this line brought out by the investigation.

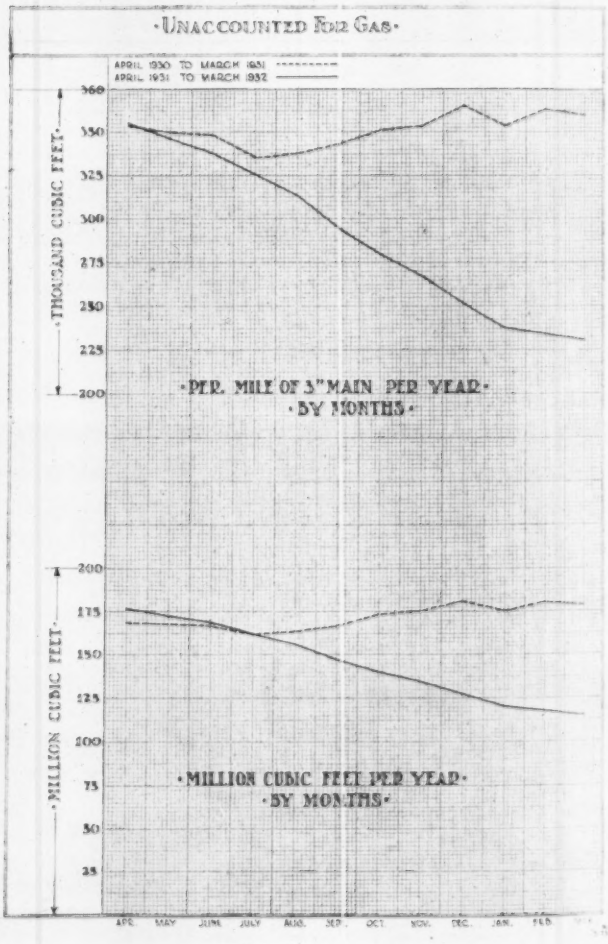
In governors where there is little or no partitioning between the inlet chamber and the under side of the diaphragm, the area is such that a high pressure rush of gas is transmitted too rapidly to the diaphragm. In going from full load to no load, the momentary lock-up pressure is exceedingly high and the governor is sensitive. As the disk becomes worn from use the initial adjustment changes, producing a higher delivery and lock-up pressure, which, in turn, develops a momentary pressure sufficiently high to blow the seal. Even though a more positive action is obtained through a large partition area, it is of no special advantage, and develops a tendency to blow.

The most important cause of blowing is the valve disk, which is constructed of leather in practically all type governors in general use on medium pressures. *The life of the disk defines the length of service of the governor, and the material being used at present, though accepted for years, cannot be termed a satisfactory.*

The treatment of leather for disk use consists usually in immersion in paraffin, beeswax, tallow or neutral oil, for the purpose of closing the pores. It has been found in service that due to the constant bombardment of gas and dust particles, augmented by the force of the valve against the seat, paraffin or its substitute is forced from that part of the disk in contact with the orifice mouth, toward the outer edge. At the same time the gas acts as an absorbent. The result is a drying out of the center of the disk with a breaking down of the leather fibres and opening of the pores. This permits creeping, and becomes very pronounced after about a year's use. Creeping may or may not lead to outright blowing, but it does permit the loss of a small amount of gas each time sealing pressure is developed on the house piping.

As near as can be determined, creeping begins immediately following the termination of the day's load. The pressure on the house side of the governor slowly builds up until sealing pressure is reached, at which time sufficient gas is passed off to lower the pressure to 9 or 10 inches. Starting at 10 inches the pressure increases until blowing pressure is again developed. This condition takes place a number of times, depending upon the amount of seepage through the pores of the disk. It is thought a minute amount of mercury is

(Continued on Page 188)


·UNACCOUNTED FOR GAS·
APRIL 1930 TO MARCH 1931
APRIL 1931 TO MARCH 1932
THOUSAND CUBIC FEET
·PER MILE OF 3" MAIN PER YEAR·
·BY MONTHS·
MILLION CUBIC FEET
·MILLION CUBIC FEET PER YEAR·
·BY MONTHS·
APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC. JAN. FEB.

The ENGINE INDICATOR

Its Design and Theory

(Continued from July issue)

6. The **magnifying gear.** The displacement of the indicator piston is communicated to the recording pencil and magnified 3, 4, 5, 6, 7 or 8 times (in normal indicators usually 6 times), by means of the recording gear. This device has to fulfill the following requirements:

a. Kinematic requirement.

1. The movement of the pencil must be rectilinear and accurately parallel to the piston motion.

2. The displacement of the pencil must be proportional to the piston displacement at all positions of the piston.

b. Dynamic requirement.

3. It must have low inertia, in order to reduce the error in the pressure recorded.

c. Constructional requirements.

4. The parts of the recording gear must be sufficiently strong and stiff to withstand the forces of acceleration without failure and flexure;

5. It should preferably be of compact design, permitting ease of handling.

In the following a number of magnifying gear types will be discussed:

a. The lemniscoid type of magnifying gear Fig. 26 has been historically the first and was used in the Richards indicator (Fig. 4.). In this case the path of the pencil point is a lemniscoid, the middle portion of which closely approaches, and has three points in common with, a straight line. Proportionality with the piston displacement is obtained if the link connecting the end of piston rod to the long arm is parallel to the connecting

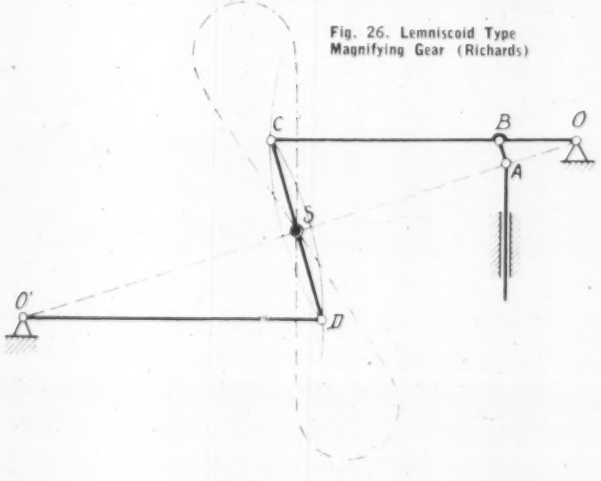


Fig. 26. Lemniscoid Type Magnifying Gear (Richards)

link bearing the pencil point. This result is attained by locating the three characteristic points: S, A, and O on one straight line as shown in the illustration. In this case the triangles AOB and SOC are similar. A disadvantage of this gear is its large dimensions owing to the distance of the two poles O and O'; furthermore, the moving masses of the arms and links are rather large.

b. The ellipse type of magnifying gear (Fig. 27) is based on the following kinematic principle: If two points A and S on a straight line move on two straight lines, x, y, which are perpendicular to each other, then any point on the straight line AS describes an ellipse, the principal axes of which lie on x and y. Conversely: if a point A is led on a straight line x and another point C is led on an ellipse of which x is a principal axis, then there is a certain point S on the straight line AC which will describe a straight line y, this latter being the other principal axis of the ellipse. In a particular case, when the point C bisects the distance AS, the point C' describes a circle.

On this principle is based the so called Evans straight line motion (Fig. 28). Point A is led in a straight slide, or, in order to reduce friction, a link guiding A in a

Fig. 27 (below). Principle of Ellipse Type Magnifying Gear

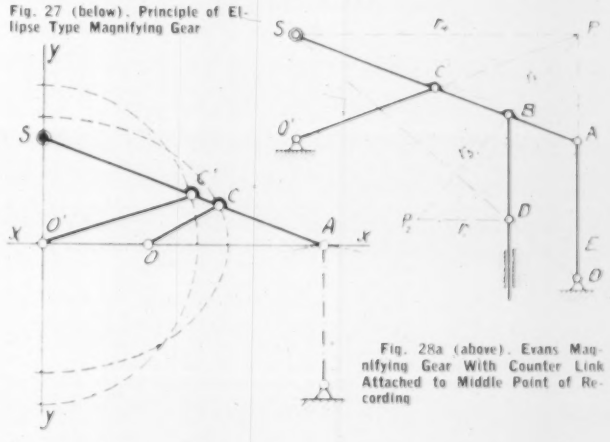


Fig. 28a (above). Evans Magnifying Gear With Counter Link Attached to Middle Point of Recording

circular arc can be substituted for the latter. In this case the path of S is not a true straight line, but approximately so within a certain range. The proportions of the Evans magnifying gear can be investigated (according to Slaby) as follows (Fig. 28a):

The instantaneous center of rotation, pole P_1 of the lever AS lies in the intersection between P of the links AB and OC'. The pole P_2 for the rod BD lies in the point of intersection between P_1B and the normal to the piston rod at point D. Denoting the velocity of the piston by v_1, of the pencil S by v_2 and that of the point B by v_3, the following relationship can be written:

$$\frac{v_1}{v_3} = \frac{DP_2}{BP_2} = \frac{r_1}{r_3} \quad \text{and} \quad \frac{v_3}{v_2} = \frac{BP_1}{SP_1} = \frac{r_2}{r_4} \quad \text{whence} \quad \frac{v_1}{v_2} = \frac{r_1 r_2}{r_3 r_4}$$

The investigation leads to the conclusion that the proportionality is greatly influenced by the position of the point D, the optimum position of which lies on the straight line OS. In this case:

$$\frac{v_1}{v_2} = \frac{OD}{OS} = \frac{ED}{AS} = C$$

where C is a constant.

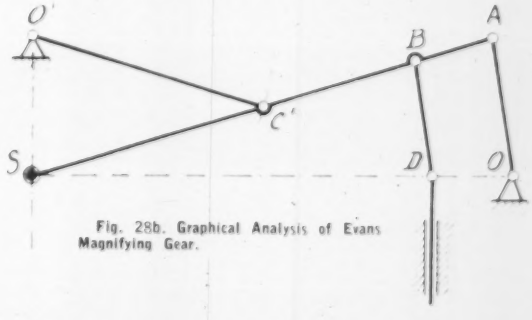


Fig. 28b. Graphical Analysis of Evans Magnifying Gear.

*Asst. Professor of Engineering Research, Pennsylvania State College.

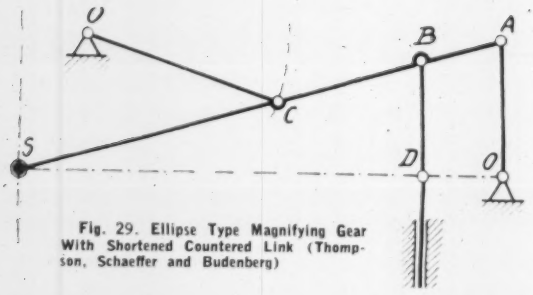


Fig. 29. Ellipse Type Magnifying Gear With Shortened Countered Link (Thompson, Schaeffer and Budenberg)

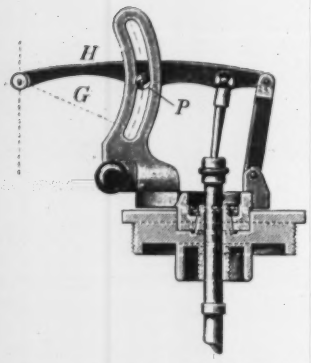


Fig. 29a. Ellipse Type Magnifying Gear With Curvilinear Slot (Tabor)

A disadvantage of this type of gear is that the pole O' falls into the path of the pencil point. In order to avoid interference, O has to be located in a plane different from the one in which the pencil arm is moving. This introduces undesirable bending and twisting moments. For this reason it has been found advantageous to deviate still more from the strict kinematic principles and use a shorter link, the pole of which is outside the path of the pencil point; in other words, to substitute a circular arc for a portion of an ellipse (Fig. 29). In spite of these compromises a satisfactory approximation to the straight line can be obtained. This type of straight line motion is used in the Rosenkranz indicator and in others.

c. With the point A moving on a circular arc the accurate straight line motion of the point S can be obtained if the point C is guided by means of a slot and roller on geometrically determined curvilinear path. The disadvantage is, however, that the friction and also the liability to backlash are greater than in the pivoted linkage of the formerly described types.

The requirement of proportionality is satisfied if the three characteristic points, i.e. the pencil point, the piston rod pivot, and the stationary pivot of the rear link lie on one straight line.

The straight line motions described under a, b, and c have the desirable property that they are self contained; i.e. the path of the pencil point does not depend on the straight line motion of the piston rod. The pencil path remains the same even if the piston rod be removed. This is not the case with,

d. The parallelogram type of magnifying gear (Fig. 30) which magnifies the path of the piston rod pivot, regardless of the path this latter describes. Therefore, whenever such a gear is used the straight line motion of the piston rod pivot must be assured. While this type of gear was employed in some older types of indicators, at present it is not being used and does not receive the attention which its simplicity and accuracy would merit. In a modified execution, however, as

e. The Crosby magnifying gear, Fig. 31, it is widely and successfully used. In this modification one point C of the connecting rod between the piston rod pivot and recording lever is caused to describe a circular arc, which has to closely approximate the path of that point corresponding to the straight line motion of the pencil point. Thus a slight deviation from the ideal straight line results, which is, however, of little practical importance. The great advantage of this gear is the smallness of the moving masses which renders it especially suitable for high speed use.

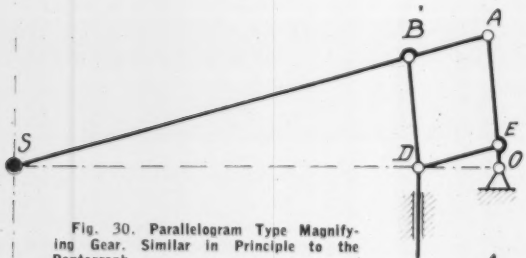


Fig. 30. Parallelogram Type Magnifying Gear. Similar in Principle to the Pantograph.

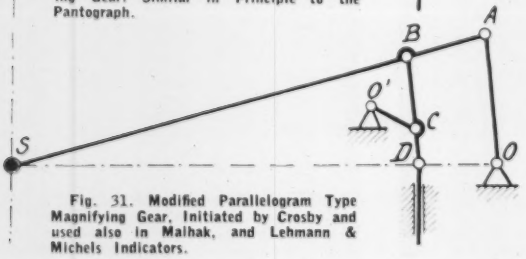


Fig. 31. Modified Parallelogram Type Magnifying Gear, Initiated by Crosby and used also in Malhak, and Lehmann & Michels Indicators.

Layout of a Magnifying Gear

In view of the wide use of the Crosby magnifying gear its design will be described in detail. The general procedure can, however, be applied also to other types.

Referring to Fig. 31a the distance of the piston axis from the ordinate to be drawn, D_1S_2, is determined from the dimensions of the indicator; i.e. center distance of piston from drum plus the radius of the latter. The point O is determined from the equation:

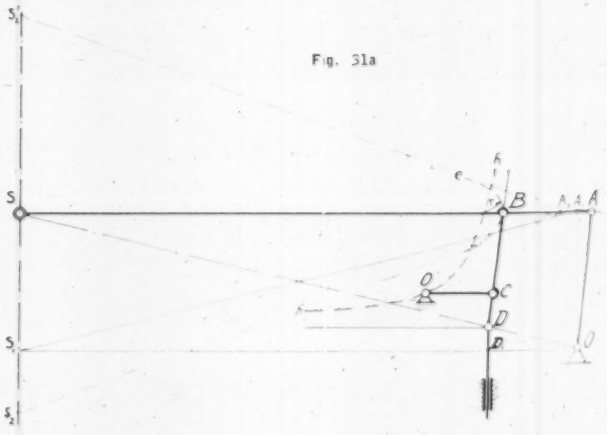
$$OS_1/OD_1 = m = \text{magnification ratio (in our case 6)}$$

The length of the rocker link $OA = \frac{1}{4}\ OS_1$ is assumed from the requirement that it should not be too long, yet should ensure that within the range of the pencil travel the arc AA_1A_2 should not deviate much from a straight line. The length of the recording lever AS is next assumed approximately on the basis that $\overline{AS}^2 = \overline{OA}^2 + \overline{OS_1}^2$ so that the rocker arm will sway by equal angles on both sides of its position parallel to the pencil path. The length of the connecting rod BD has to satisfy the requirement of proportionality of displacement for pencil and piston, i.e.:

$$\frac{OA}{BD} = \frac{m}{m-1}$$ where m is the desired magnification ratio.

There remains to be determined the location of the fixed center O' and the length of the counter link O'C. Let us place the magnifying gear into its middle position, i.e. where the recording lever is perpendicular to the pencil path. (This position is drawn on Fig. 31a in heavy lines.) Point B on the recording lever describes an ellipse e having a major axis BS and a

Fig. 31a



minor axis equal to AB. In accordance with the property of an ellipse, the radius of curvature at the end of the major axis will be:

$$r = \frac{\overline{AB}^2}{\overline{BS}}$$

with center located on the BS line perpendicular to the pencil path. The other end D of the link BD is guided by the piston on a straight line parallel to the pencil path. This motion can be regarded as a rotation around a center in the infinite located on a line through D normal to the pencil path. The normal at any other point of the link BD will therefore be perpendicular to the pencil path. The respective radius of curvature of any given point C will be inversely proportional to its distance from the point D, i.e.

$$\frac{\text{radius of curvature at C}}{\text{radius of curvature at B}} = \frac{DB}{DC}$$

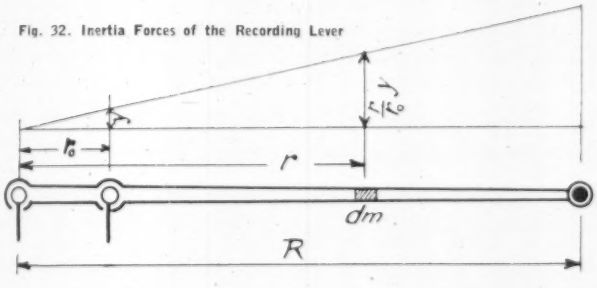
The centers lie on a hyperbola h the two asymptotes of which are DB produced and the normal at D. Any point of this hyperbola connected to a point on the link DB by a line normal to the pencil path S_2 S′ gives the respective radius of curvature. In actual designs an approximate value

$$DC = 1/3\ DB$$

can be chosen, which gives a link of convenient length.

From the point of view of the *dynamic requirements* it has to be borne in mind that to the various elements of the recording gear various accelerations (translatory, rotary, or both), are imparted whenever the piston is displaced. In a complete analysis all these accelerations have to be resolved into components parallel with, and components perpendicular to, the piston motion. It is a problem of no small intricacy and can be best done by graphical operations. For the present however, only that element of magnifying gear will be dealt with, the influence of which is the greatest because of its large travel; that is, the recording arm itself.

Fig. 32. Inertia Forces of the Recording Lever



Taking an elementary portion of this lever having a mass *dm* at distance r distance from the fulcrum, (Fig. 32) its acceleration will be

$$\left(\frac{r}{r_o}\right)\left(\frac{d^2y}{dt^2}\right)$$

where r_o = radius of point of attachment of piston rod
y = its travel

the force to be exerted in order to impart this acceleration, dP′, is given by the equation

$$dP' = dm\left(\frac{r}{r_o}\right)\left(\frac{d^2y}{dt^2}\right)$$

The force is applied, however, by the piston at r_o distance from the fulcrum and this force will be equivalent to:

$$dP = \frac{r}{r_o}dP' = dm\left(\frac{r}{r_o}\right)^2\frac{dy}{dt}$$

and for the entire lever

$$P = \frac{dy}{dt}\int\left(\frac{r}{r_o}\right)^2 dm$$

The value of the integral is the "equivalent mass" of the lever, which can be expressed:

$$\text{equivalent mass of lever} = \frac{1}{r_o^2}\int r^2\,dm = \frac{I_p}{r_o^2}$$

in words: the equivalent mass of the recording lever is equivalent to its polar moment of inertia for its fulcrum as a pole, divided by the square of the distance of the piston rod joint from the fulcrum.

This simplified analysis does not take into consideration the motion of the fulcrum. Owing to this the equivalent mass is not, strictly speaking, a constant quantity, but has a different value at different piston positions. This analysis is adequate, however, to show that it is especially important to keep the mass of the pencil and its fastening small, because its equivalent mass is equal to

$\left(\frac{R}{r_o}\right)^2$ times its actual mass. With a magnification ratio of six this makes the equivalent mass of the pencil equal to 36 times its actual mass.

Constructionally the links forming the recording gear have to be strong and stiff enough to withstand the accelerating forces without failure or flexure, yet as light as possible, in order to reduce the inertia errors.

The material of the links is usually high tensile steel, formed to suitable cross section to resist flexure in the plane of bending forces. In some cases hollow tubes, formed to an elliptical cross section, are employed. (Geiger's Indicator manufactured by Lehmann & Michels.) Longitudinally the main recording lever is shaped to form a beam of equal strength.

The joints are formed by hardened pins with as little backlash as possible. A backlash in a joint would appear at the writing point multiplied by the ratio of magnification, and is therefore very deleterious, especially with high ratio of magnification.

One can find out the magnitude of the backlash by blocking the piston rigidly in a certain position and pressing the pencil up and down and sideways. The backlash of good indicators should not exceed 1% of the total range.

The stationary joints of the recording gear are fastened onto a platform which can be rocked around the cylinder axis as pivot, thus enabling the pencil point to be brought into contact with, or be removed from, the drum.

Most recording gears used in inside spring indicators and also in some of the outside spring type have their links situated in the plane of the cylinder axis. Or, where this is not feasible as in most outside spring indicators, the links are duplicated symmetrically in order to bring the accelerating forces into the plane of the piston rod. Besides avoiding side thrust on the piston this arrangement has the advantage in that the recording gear can be completely turned around its axis and the pencil can be brought into contact with either side of the drum. This feature allows the indicator to be used as a right-handed or left-handed instrument, which is a real convenience in some cases.

Some types of recording gear have their links located in different planes. In some makes of indicators even the whole recording gear is located in a plane outside the piston rod. This method of construction has the disadvantage of exerting bending forces and side thrust on the piston rod, and also on the linkage, resulting in increased friction. The eccentricity has to be reduced to as small a value as possible. It is on the whole preferable to locate the recording gear in the plane of the piston rod.

In present day indicators a small silver or brass point is used as a pencil. This gives a finer line, when used on a specially coated paper, and keeps its fine point longer than does a lead pencil, which was generally used formerly. Attention has to be paid to the fastening of the pencil point into the end of the recording lever. The fastening must be firm enough to prevent the pencil

from shaking loose under the influence of vibrations, yet it has to be as light as possible, on account of the inertia errors involved. It has to be borne in mind that the mass of the pencil point produces an inertia force in the piston axis equivalent to its mass multiplied by the square of the multiplication ratio. A number of pencil point constructions are shown in Fig. 33.

Considerable weight can be saved by careful design of the pencil point. One type, with a large knurled head, examined by the author, weighed 0.3 gram. Another type, with a small slotted head, weighed 0.1 gram. Their effective weight at the piston axis was—according to the 6 times magnification—6^2 times as much, *i.e.* 10.8 grams and 3.6 grams respectively, giving 7.2 grams difference in favor of the lighter pencil: a very worth while saving.

The pencil is brought into contact with the indicator card by means of a knob attached to the recording gear carrier. The movement is limited by means of a stationary stop on the frame in conjunction with an adjusting screw. Usually the contact is established by pressing the knob with the hand. In cases where the indicator is not accessible during indicating, as for example on locomotives, or where a number of indicators have to be operated simultaneously, the contact can be brought about by means of remote control. An electromagnetically operated contactor is shown in Fig. 34.

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Small Gas Regulators and Unaccounted for Gas (Continued from Page 184)

displaced each time the gas is permitted to escape. If the action is rapid enough, sufficient mercury is displaced to either blow the governor, or upon resumption of the morning load, to bring about blowing through a normal lock-up pressure operating against a reduced sealing medium.

In substantiation of creeping, due to open pores and broken down fibres, it is found that but 45% of the blowing takes place on governors supplying pilots, while 55% occurs on governors on which there is no pilot. The continuous flow pilot, therefore, takes sufficient of the excess or seepage gas to extend the building up of pressure over a protracted period of time.

Blowing produced by dust may be of two types; the instantaneous blowing, due to heavy particles lodged in the disk groove during demand periods, followed by uneven seating after the load is discontinued, and the blowing produced when small moist particles of dust build up a false, porous, wall in the indentation made by the orifice against the disk. This latter type permits creeping similar to that caused by broken down fibers.

SUGGESTED GOVERNOR IMPROVEMENTS

It appears, therefore, that the problem resolves itself into a satisfactory material for use as a valve. A sharp mouth orifice design on the valve seat increases the "bite" of the seat, into the disk, and lessens the possibility of seepage, but at the same time shortens the life of the disk. A rounded mouth orifice will, on the other hand, increase the life of the disk, but its wide groove presents a trough in which dust accumulates and produces blowing. It is necessary, therefore, to either sacrifice long disk life for positive shut-off, or the reverse, for the two are interdependent.

Effort is being made to obtain a satisfactory disk material. At the present time, four compositions are under test, and the return rate of governors containing each is being closely followed. The tests have not been carried on for sufficient time to determine anything definite; however, it is believed that the materials under observation are all more satisfactory than leather.

While the loss of gas brought about through both blowing and seepage is appreciable, it is thought that a greater portion can be traced to the seepage, which determines the trend of the unaccounted for gas curve. This deduction is made from the fact that during a number of years in which the blowing rate remained fairly constant, the amount of unaccounted for gas was increasing.

In conclusion, it might be said that while little or no improvement has been made on the governor itself, enough evidence has been obtained to establish the fact that loss of gas through governors is noticeably reflected in the unaccounted for gas, and is therefore of sufficient importance to warrant handling governors more in accordance with handling of meters than of bagged fittings. Consideration of the possibilities of future saving stresses the necessity for more thorough research, in an effort to produce a governor of such design that blowing and its contributing factors are minimized.

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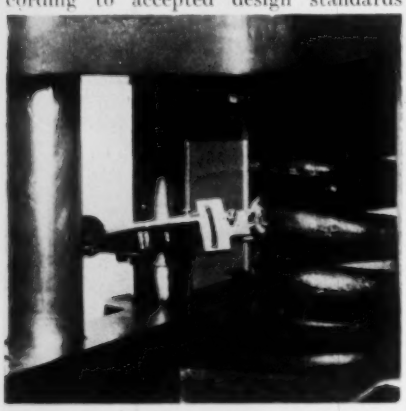
Measuring the Stresses in a Coiled Spring

HEAVY coiled springs, like those under railroad cars, often break, although they have been built according to accepted design standards and formulas. Such failures caused A. M. Wahl, a Westinghouse research engineer, to make some unusual tests. He found the actual shearing stress in a spring was very much greater than that accepted by engineers.



The extensometer mounted on the spring revealed the magnitude of the stresses. He found that stresses inside the spring are often two and one-half times as great as those on the outside where measurements had always been taken. With these new facts it was a simple matter to design and make springs of the proper cross section and strength to eliminate breakage under the required loads.

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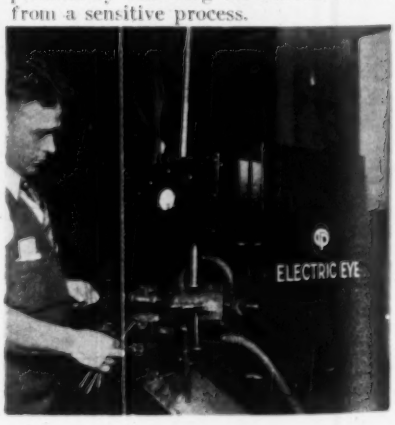
Electric Eye to Measure Valve Tip Hardness

TIP HARDENING of valves at a Cleveland plant is done by a Westinghouse "Electric-eye," which accurately gages the heat by recognizing its change in color during heat treatment. The operator passes an electric current through the tip. At the proper heat the photo cell shuts off the current and automatically releases the valve into an oil quench. This new device has solved a difficult and tricky operation giving a better product by removing the human element from a sensitive process.



Flow Measurement and Control*

By M. F. BEHAR**

CHAPTER XXV HEAD METERS

(Continued)

14. Dial Indicating Manometers

(a) Uses, Classes, etc.

The dividing line between glass and dial indicating manometers cuts through *one functional group*, namely the indicating devices, this group to be followed by other distinct functional groups of devices dealt with in the remaining sections. Some authorities consider it the only important dividing line, separating "manometers" (fluid manometers with visible columns) from "commercial meters" or, from "mechanical and electrical flow meters." Opposed to this view, the author believes that the only particular significance of this line is that it divides one class of manometers (all forms indicating, some forms unsuitable for plant service) from several classes of manometers *all of them industrial*, whether indicating or recording, whether "mechanical" or "electrical."

To design a visible-column manometer with a uniformly graduated flow-rate scale, it is necessary to sacrifice the straight tube of uniform bore which is an essential feature of the precision forms. While this problem has never been solved *completely* in *any* head meter, many satisfactory solutions are available in the industrial recorders, and some of the makers of these instruments supply non-recording instruments embodying the same feature. As a rule, though, the dial indicators are of simple design and construction, with the "progressive" quadratic scale. Not only is the demand for uniform scales less insistent than in the case of recorders (the charts of which often have to be computed) but most indicator installations are on process applications where the differential is fairly constant (except for surges—see next paragraph) so that the open graduations in the upper part of the square-root scale make for easy reading and are frequently preferred.

Provisions against blow-over of the manometric liquid by reason of excessive differential were noted in the preceding section, as features of some "industrialized" glass manometers. They are the rule and not the exception in dial indicators.

Excessive line pressure, of less frequent occurrence than excessive differential, is less to be feared where a dial instrument is installed, not so much because the factor of safety is *higher* than that of a glass manometer but because it is a practically certain quantity, whereas glass fails without known reason far more frequently than metals and alloys.

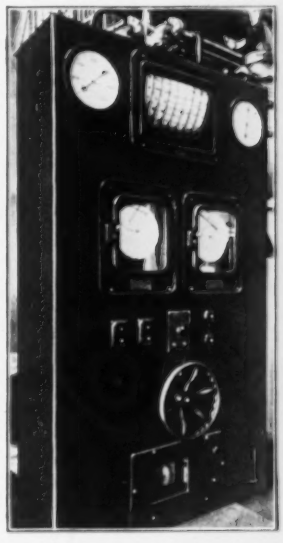
The fragility of glass manometers is another consideration. Here, the initial cost of the dial indicator is usually higher—but this is obviously justified.

An increasingly important use for dial indicators is checking the performance of recorders, controllers and combination instruments operating from the same primary elements. A few years ago the rule was to install a glass U-tube, just as it was the rule to install a glass thermometer beside a recording thermometer on temperature applications below 750° or 800° F. The increasing popularity of dial-indicating thermometers is paralleled. The growing tendency to group instruments on panel boards is said to be a factor in this situation, but panel boards, to our way of thinking, are not a cause but a symptom: an evidence of preliminary planning. In other words, indicating, recording, totalizing and controlling flow instruments are no longer an afterthought.

Where an electrical remote-reading system is decided upon, the addition of an easily-read indicator beside the recorder or combination instrument on the panel at the receiving end amounts to a relatively small increase in first cost. Such an indicator, however, if operated from the same manometer body, should not be considered a checking instrument: All it checks is a portion of the elec-

*Part Six of *The Manual of Instrumentation.*
**Engineering Editor.

FOR BOILER CONTROL



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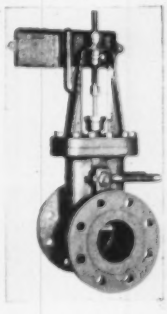
Bailey Meter Selsyn Operated Equipment for recording and indicating pressure, temperature, draft, liquid level, etc. at any distance from the source is highly accurate and reliable. Described in Bulletin No. 110.



ADJUSTABLE ORIFICE

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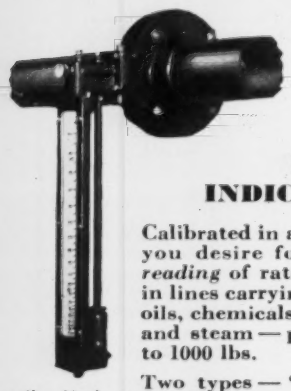

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MANUFACTURERS' LITERATURE

In this department we list each month the printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

212 Double Monochromator. Publication No. 169 describes the Universal Double Monochromator. Adam Hilger, Ltd. 98 Kings Road, Camden Road, London, N.W.1.

213 Frequency Monitor. A leaflet illustrating visual indicating frequency monitor which was designed to provide an immediate and accurate indication of deviation of frequency from a broadcasting station's assigned value. Doolittle & Falknor, Inc. 1306 W. Seventy-fourth Street, Chicago, Ill.

214 Rotameter. A leaflet describing the rotameter which is a non-recording instrument designed to show rates of flow in pipe lines carrying water, oil, chemicals, other liquids, air or gases. Schutte & Koerting, 12th and Thompson Streets, Philadelphia, Pa.

215 Relays. A 4 page circular describing several continuous current relays. Hart Manufacturing Company, Hartford, Conn.

216 Indicating Caliper. Bulletin No. 106 Production Data, features the performance, application and operation of an improved device for checking roll accuracy to within one-quarter (.00025") to one-tenth (.0001") of one thousandth inch. Farrel-Birmingham Company, Inc. 723 Main Street, Ansonia, Conn.

217 Hardness Rocker. Circular No. 409, Issued May, 1932 describes a new instrument known as "Hardness Rocker Apparatus" used for testing the hardness of surfaces. American Paint and Varnish Manufacturers' Association, Washington, D. C.

trical system. For checking such installations *as flow meters*, a glass U-gage or dial indicator should be connected to the primary device itself.

Electrical indicators, remotely located from their initiating devices actuated by secondary elements of head meters, need not be discussed and described separately in this section, and dial indicators, as differential pressure measuring instruments, do not include a separate electrical class except insofar as the actual *head measurement, at the transmitter*, is performed electrically. (Examples, the *mercury* in one leg of a modified U-tube contacting a number of resistors proportional to its level, as in the Republic meter bodies; or increasing the primary circuit admittance, as in the Bailey.) This distinction, though important to industrial users, seems to have been overlooked by every writer and even by committees presenting reports.

In general, then, the dial indicators may be classified along the same lines as the recorders. Inasmuch as some measuring principles employed in recorders are not represented in the indicators, these latter need only be divided into broad classes, in order that this section will serve as a sort of introduction to the more complicated instruments available in great variety.

One widely-employed general classification is into "electrical" and "mechanical" but we do not favor it, for the "electrical" label tends to be attached to any system consisting of a mechanical head-measuring instrument *plus* any telemetering circuit. Another division is into fluid manometers and diaphragm manometers, which gives two truly mutually-exclusive classes — neither of which, however, is comprehensive. "Wet" or "dry" would seem to be a better expression, being incidentally an accepted division of positive-displacement gas meters.

Instead of attempting an ideal classification, we may conveniently list a few types, as follows:

Modified U-gage, with float
Modified U-gage, electrical
Modified U-gage, ring or tilting
Modified U-gage, one leg weighed by spring balance
Inverted bell
Other gravitational forms
Elastic-member forms
Piezoelectric

These are self-explanatory, except the electrical, which was explained above, and the piezoelectric which is not designed to cover all pressure-electrical effects (as the Greek prefix would imply) nor all instruments with piezoelectric crystals and carbon disks designed for high-pressure measurement, but only carbon-grain and other low-pressure electrical measurement methods applicable to the low and medium differential heads actually produced by usual primary devices.

(b) U-gage and Float

These elements are by far most widely employed in the recorders, and in at least three United States makes of indicators. From these, that of the Metric Metal Works, American Meter Co., may be selected as type example. Its features are mostly apparent from Figs. 25-114 and 115. It is designed for 800-lb. maximum static pressure and is furnished in differential ranges of 2½, 50 or 100 inches, together with primary device, connections, seals when necessary,

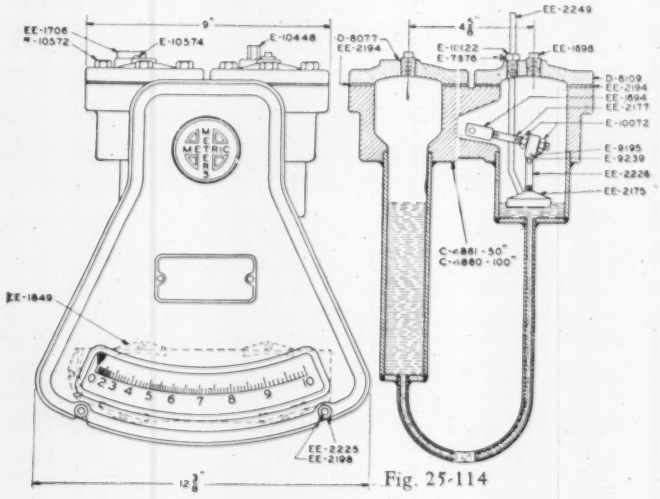


Fig. 25-114

etc., as a complete flow meter. Fig. 13-116 shows an assembly including reservoirs for a caustic solution metering application. Each instrument contains 7 lb. or 14 cu. in. of mercury.

In this connection an interesting characteristic of practically all the U-gage forms of indicators and recorders may be pointed out: that their *sensitivity* depends on the quantity of manometric fluid. A rigorous analysis discloses numerous factors of design, such as float area and dimensional ratios; and of construction, such as stuffing boxes, bearings, recording pens, etc.; but in the end the development engineer (or the critic) must admit that in order to obtain both unit sensitivity and ultimate sensitivity *without sacrificing intrinsic accuracy* one must provide a large volume of mercury or other liquid.

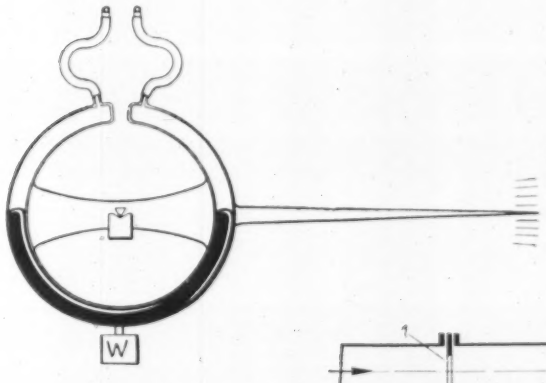


Fig. 25-117

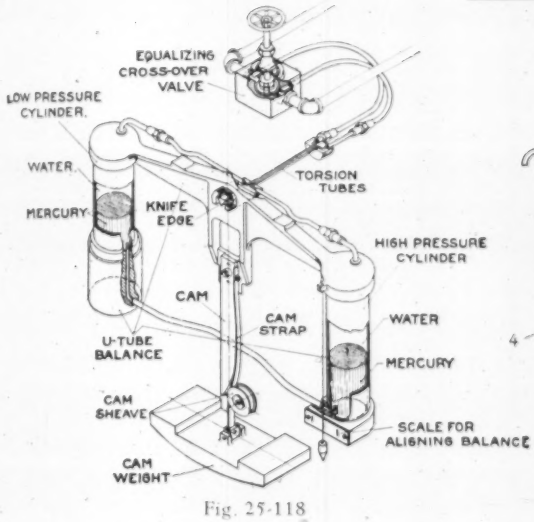
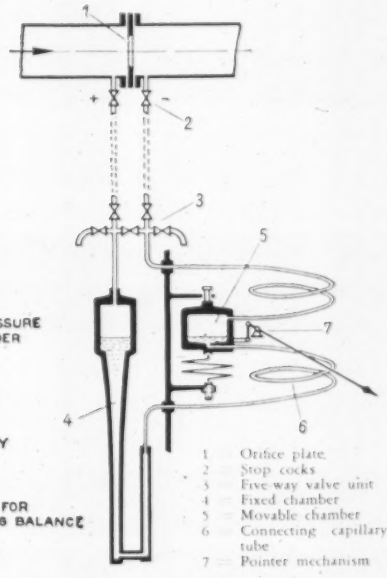


Fig. 25-118



1 — Orifice plate
2 — Stop cocks
3 — Five-way valve unit
4 — Fixed chamber
5 — Movable chamber
6 — Connecting capillary tube
7 — Pointer mechanism

Fig. 25-119

(c) U-gage, Electrical Measurement of Head

It appears that plain indicators are not readily available. Recorders using this method, such as the Bailey, Brown, Republic, etc., are described individually below, and Chap. XXVIII analyzes all electrical remote-reading systems applicable to flow metering.

(d) Ring and Tilting U-gages

The principle of this method is shown in Fig. 25-117. Note that extreme sensitivity is afforded at low rates of flow and that the scale closes up at high differentials. Although ideal simplicity cannot be realized in actual indicators and recorders, these are easily constructed with uniformly graduated flow scales. Details of the Askania Ring instruments are given below under recorders. The Cochrane Corp. has fully developed the tilting principle, and its line includes a round-case indicator with circular scale 42 in. long uniformly graduated for quantity-rate. Fig. 25-118 shows some details of construction. Note that owing to small diameters, parts can withstand extremely high static pressure. Four differential ranges are available. By changing a few parts, an instrument may be converted from one range to another.

A practical advantage of ring and tilting types is that by use of calibrating weights they can be checked without reference to other instruments. Such

218 Field Balances. Pamphlet, Geo 92E, entitled, "Magnetic Field Balances." The use of magnetic methods of prospecting in order to locate useful mineral deposits as made with the Ad. Schmidt field balances is described. American Askania Corp. 1024 Marine Bank Bldg., Houston, Texas.

219 Aircraft Instruments. Pamphlet Aero 101 E is intended to convey a general idea of the aircraft instruments. American Askania Corp. 1024 Marine Bank Bldg., Houston, Texas.

220 Stress-Strain Recorder. Circular A 129 describes the stress-strain recorder, which draws a stress-strain curve. Baldwin-Southwark Corp., Passchall Station, Philadelphia, Pa.

221 Air Filters. A 16 page descriptive catalogue on filters and their application in the commercial-industrial field. Owens-Illinois Glass Company, Toledo, Ohio.

222 Dairy Equipment. Application Book No. 3200 explains where and how to use automatic controls and recording instruments in the dairy industry. The Bristol Company, Waterbury, Conn.

223 Meter Tester. A broadside describing a meter tester which is quickly operated. There are no loose weights to confuse the operator and percentage readings are based on the amount of water actually passed by the meter. H. W. Clark Company, Mattoon, Illinois.

224 Spectrographic Analysis. Illustrating instruments for Spectrographic Analysis. Bausch & Lomb Optical Co., Rochester, N. Y.

225 Operation Recorder. Circular from Practical Instrument Co., 2717 N. Ashland Ave., Chicago, Ill.

226 Diaphragm Meter. Bulletin No. 236-A illustrates the Diaphragm Meter, Type GK which registers, indicates and records the flow of fluids. Builders Iron Foundry, Providence, R. I.

227 Electrified Facilities. A four-page folder describes some economies to be effected by modern applications of electrical equipment in shops, engine houses, and freight yards. The folder is identified as E.M.F. 5421. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

228 Rheostats. Bulletin 1330 offers distinctly new features of the "Jagabi" Rheostats. James G. Biddle Co., 1211-13 Arch Street, Philadelphia, Pa.

229 Precision Mixer. A single sheet illustrating the precision mixer. This mixer is an attachment for operation on the Hobart Model C-10 Mixing Machine. The Hobart Manufacturing Company, Troy, N. Y.

230 Generator Temperatures. Circular F-142-G, describes generator temperature recorders which give temperature trends and stand ready to ring for help if temperature climbs too high. Leeds & Northrup Co., 4901 Stenton Avenue, Philadelphia, Pa.

231 Relay. A leaflet describing a supersensitive relay which controls relatively heavy currents through the limited mechanical impulse of thermostat action or through variations in electrical resistance set up by varying the intensity of light striking a photoelectric cell. American Instrument Co., Inc., 774 Girard St., N. W., Washington, D. C.

232 Industrial News. The title of a house-organ newspaper devoted to electrical control equipment. Square D. Company, Milwaukee, Wis.

233 Overhead A. C. Network System. Circular C-1944 covers the new application of economical secondary low voltage networks to low density load areas fed by overhead lines. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

234 Polaricode Control. Circular C-1948 describes the operation and construction of the radically new Polaricode split-second supervisory control. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

235 Calorimeters. Catalogue C-1 entitled Studentia Calorimeters. Three other bulletins issued by the same company are: Bulletin 129, "Mechanical Equivalent of Heat Apparatus" Bulletin 131, "Polariscopes and Accessories," and Bulletin 130 "Scientia Gas Calorimeter." Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago, Ill.

236 Tester. Folder No. 408a, A reprint from the "World's Paper Trade Review," dated May 8 and 15th, 1931, entitled, "Beating and Freeness Tester," an apparatus for determining the freeness of paper, pulp, cellulose and me-

237 Anemometer. Bulletin No. 68. Mine Safety Appliances Co., Braddock Ave. and Thomas Blvd., Pittsburgh, Pa.

238 Vacuum Tube. A loose leaf article entitled, "Vacuum Tube Now Detects Fire" by Allen C. Forbes. Skala Research Labs., 2300 South 56th Ave., Cicero, Illinois.

239 Pyrometer. Prospectus No. 269 features the P2 new pocket pyrometer measuring range 900-1800° C. approx. Spindler & Sauppe, Inc., 86 Third St., San Francisco, Calif.

240 Pressure Measuring Instruments. A circular announcing standard apparatus for producing and for measuring high pressure. Circular MAC 31 shows the improved model Analytical Balance, also circular Mono 32 describes the double Monochromators with optical systems of glass or quartz. P. J. Kipp & Zonen, Delft, Holland.

241 Balances. Technical Data Sheet No. 6 introducing price list and features of balances used in the textile industry. Roller-Smith Company, 233 Broadway, New York.

242 Experimenter. "Bridge Methods for Measurements at Radio Frequencies" is the title of the article in the July 1932 issue of The General Radio Experimenter. General Radio Company, Cambridge A, Mass.

243 Pilot Regulator. A 4 page bulletin describing the Jet Pipe Regulator which is used to maintain a constant predetermined condition. This condition may be one of pressure, draft, water level, tension, speed of rotation, etc. H. A. Brassert & Company, 310 So. Michigan Ave., Chicago, Ill.

244 Air Meters. Bulletin A-6 describes air meters used for comparing the air consumption of different makes of equipment. Another piece of literature by this same company listed as Blower Bulletin illustrates forge and gas furnace blowers. The New Jersey Meter Co., Plainfield, N. J.

245 Mining and Scientific Instruments. Two circulars describing various magneto blasters, leading wire reels and hand reels and direct reading anemometers. Davis Instrument Manufacturing Co., Inc., 513 East 36th St., Baltimore, Md.

246 Gas Indicator. Bulletin No. 72 describes the combustible gas indicator, a simple, practical, direct reading instrument for testing explosive gas hazards. Mine Safety Appliances Company, Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

247 Steam-Operated Controller. Bulletin 1024 presents the new Tag Steam-Operated Controller. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.

248 Relays. Circular GEA-1583 describes high-speed, directional distance, directional over-current and time induction relays. General Electric Company, Schenectady, N. Y.

INSTRUMENTS, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below:

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Name.....

Position.....

Firm.....

Street and No.....

City.....State.....

NEW NEW
Multy-Purpose Laboratory Balances
Combining in one instrument for one Price
THE ANALYTICAL BALANCE
THE MICRO-CHEMICAL BALANCE
THE ASSAY BALANCE
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The HEUSSER INSTRUMENT MFG. CO. Makers
165 Pierpont Ave., Salt Lake City, Utah
Bulletin 37 tells the whole story. A postal card will bring it to you.
NEW NEW

checking is for one point and generally suffices for an instrument which has carefully been factory-calibrated.

(e) Spring-balanced Leg U-gage

Figs. 25-119, 120 show the Askania Werke's indicator employing this principle (distributed in United States by American Askania Corp.) and are self-explanatory. Note the attainment of a uniform scale for flow by the use of a parabolic liner for the unweighed leg, "so calculated that the quantity of mercury passing into chamber 5 is proportional to the square root of the differential." The spring is purely a *weighing* spring, is not subjected to high temperatures or corrosive fluids, and can therefore be selected from a wide choice of *measuring* springs.

(f) Bell Types

(Will be dealt with under recorders. For an extended treatment see Part Four, Chap. XVII.)

(g) Elastic-member

The aircraft instrument industry, guided by the Bureau of Standards and other research bodies, has developed the most highly perfected differential pressure indicators employing capsular spring, diaphragms, and other elastic members. Metallurgical research has in recent years produced alloys capable of being stamped, spun, drawn, etc., to the desired forms and dimensions and yet combining the various properties that instrument springs should possess. For detailed discussions see Part Four, Chap. XVII, § 8. Head metering instruments of the differential bellows and diaphragm types abound in Europe where the standards of ruggedness, accuracy and sensitivity *for this kind of meters*

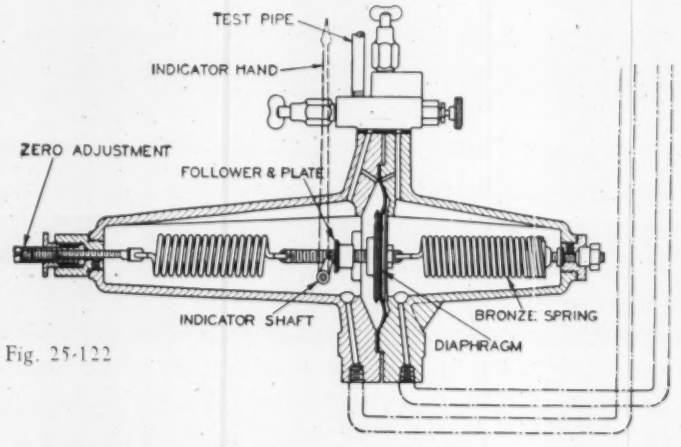

Fig. 25-122

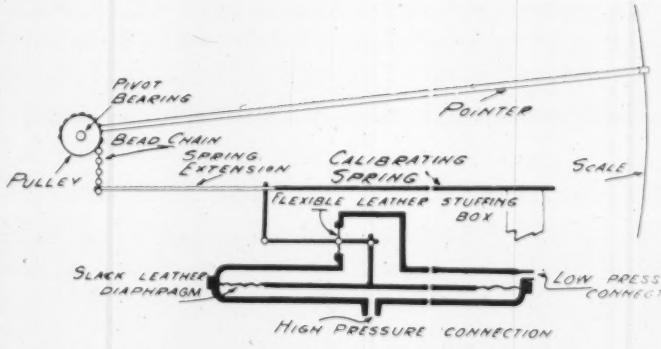

Fig. 25-123

do not seems to be high, judging from available descriptions. In this country, elastic-member instruments must compete with numerous gravitational instruments for the same classes of industrial applications. That is why there are few in the field of head metering; that is why these few perform well.

Two diaphragm instruments are selected as type examples: that of Builders Iron Foundry, Figs. 25-121, 22, with B.I.F.'s own primary devices and measuring up to 60 in. water head at the usual steam pressures; and the Hays Corp.'s small edgewise unit, Figs. 25-123, 24, developed especially for air flow measurements where the boiler furnace or other application is itself the "differential producer," and characterized by a slack gold-beater's skin membrane and flat measuring spring permitting 12 ranges from 0-0.6 to 0-8.0 inches of water where the zero point is usually below atmospheric.

NEW INSTRUMENTS

Recently Developed by Manufacturers

Write Information Section, Instruments Publishing Company, for additional Information.

Pneumatic Switch

The Foxboro Co.

A SIMPLE, compact pneumatic switch has been designed by this company for use with their standard temperature and pressure controllers. This switch makes possible the use of air-operated controllers on equipment that is controlled by turning on and off an electric current. It has been used successfully to control temperatures in electrically heated ovens, to control moter operated pumps, blowers and compressors, and as a means of producing audible or visible signals on time cycle applications.

The switch is a standard single pole mercury type switch mounted in a small cast-iron housing with an outlet tapped for either conduit or BX connector. In conjunction with suitable auxiliary magnetic switches, it may be used in any circuit where the current is not higher than 600 amperes at 220 volts. Operation is by a small diaphragm motor mounted directly on the housing. The standard switch is closed by air pressure from the control instrument and opened by a spring. The switch is, therefore, always open when the air is off.

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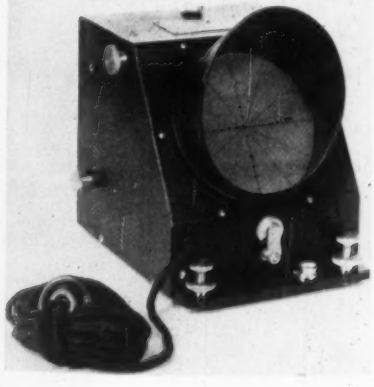
Two-Component Vibrometer

Electrocon Corporation

THIS INSTRUMENT measures the vertical and horizontal vibrations simultaneously, when laid down on the object whose vibrations are to be measured. A spot of light traces out the exact path of the vibration, magnified many times, on a ground glass scale. It will measure frequency and phase position in addition to amplitude if used in conjunction with the Davey portable balancing equipment.

The illustration of the circular ground glass scale, which is four inches in diameter, shows the way a typical vibration reading appears. In this case the vertical vibration amplitude is 6 mils and the horizontal vibration is 4 mils. The faint track of light which appears to the right of the main indication is explained further below.

The instrument works on the principle of the seismograph, the main element being a weight suspended on springs. When the instrument is subjected to vibration above a certain frequency, this weight will remain inert in space, partaking of no motion from the vibration in either direction. A novel method of suspension makes possible the use of an unusually light weight and at the same time a low natural frequency of oscillation. A small concave mirror carried on a spindle is mounted on the weight and light from a small incandescent bulb passes through a small aperture and is reflected by the mirror in the form of a round spot of light on a ground glass scale. In order to magnify the relative motion between the weight and the rigid frame of the instrument, a silk thread fastened to the frame is wrapped around the mirror spindle. This is exactly the same as the method used in this company's earlier single direction vibrometer, except that the mirror is pivoted in both directions. If the vibration is in one direction only, the oscillation of the spot of light will make it appear as a straight line in that direction; vibrations equal in both directions will produce a circular track of light, and unequal amplitudes in the two directions will produce an elliptical light track as illustrated.

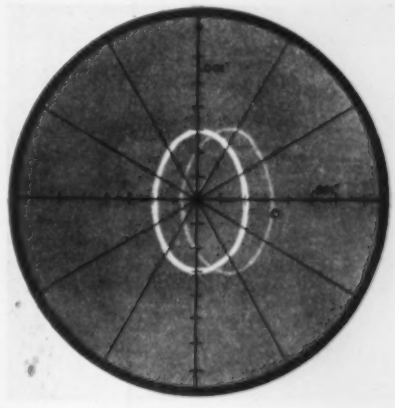


The natural frequency of oscillation of the weight is slightly under 100 per minute, which means that the instrument will indicate accurately the amplitudes of vibrations of frequency above 400 per minute and up to approximately 6,000 per minute. Good comparative readings may be obtained at frequencies below 400 per minute, but to obtain the actual amplitudes of these vibrations the instrument must be calibrated.

The instrument is supplied in two standard sensitivities, model S-2A which magnifies the vibrations approximately 500 times and model S-2B which magnifies approximately 250 times. Special sensitivities may be supplied if desired.

Excellent photographic records may be obtained of any repeating vibration. A standard film holder is supplied with each instrument and this slides into a slot immediately behind the ground glass scale. To obtain a permanent record of a vibration the light beam is adjusted to the center of the scale, then the film holder is slid into its slot and the film is exposed for about five seconds. The manufacturer supplies facsimiles of the scale graduation which are superimposed upon the light beam photographs when making prints.

This instrument when supplied with a neon tube may be used in conjunction with the Davey Portable Balancing Equipment. When thus used, the mirror reflects simultaneously the steady white light from the incandescent bulb and the interrupted red light from the neon tube. If the neon tube is caused to flash at exactly the frequency of the vibration, a single stationary red light spot will appear on the scale and similarly, if the flash frequency is twice the vibration frequency two stationary red spots will appear, again if the flash frequency is slightly out of synchronism with the vibration frequency the red spot will appear to be slowly traveling around and following the path of the white light beam. In order to avoid confusion of the two light beams, the red light is reflected slightly to the right of the white, the red spot being superimposed upon a very faint track of light which runs parallel to the main indication. This may be seen in the illustration, the red spot being shown superimposed on the faint track, just below the horizontal line. The other parts of the Balancing Equipment provide the means for producing the light flashes in the neon tube and for a full description of the application to dynamic balancing and vibration analysis, refer to literature on this subject provided by the manufacturer.



Approximate dimensions are: height 7 in., length 7½ in., width 5½ in. Weight is 8 lbs.

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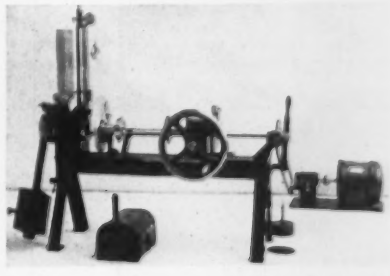
Torsional Strength Tester

Testing Machines, Inc.

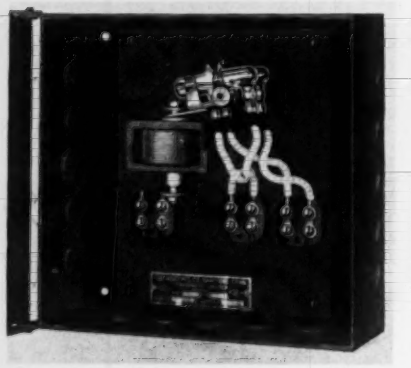
THE TORSIONAL strength tester determines the torsional moment developed in twisting a wire or rod through 360 degrees. From then on the test can be continued to determine the number of twists required to rupture. The machine is equipped for the two testing ranges 0 to 75 and 0 to 300 in. lbs. Scale readings are provided for both clockwise and counter clockwise twists. The machine is equipped with a graphic recorder for making stress-strain diagrams. The machine can be either hand or motor driven. The testing length can be adjusted up to 8 in. For determining the angle of twist a scale is provided (for both right and left twists) with readings 0° to 360°. A set of loading weights come with the tester, by means of which a constant tension may be maintained on the specimen during the test. This tension may be varied according to the nature of the specimen, for which purpose a set of load weights is provided.



Mercury Tube Relays

Hart Manufacturing Co.

THESE RELAYS have been designed for controlling loads up to 25 amps. at 125 volts, by means of a low amperage secondary circuit. The coils are of the continuous current type and are wound for 110 or 220 volts a.-c. or d.-c. Special low voltage coils as low as 6 volts d.-c. may be supplied.



These relays are, according to the manufacturer, positive in action, silent, fool-proof and will stand up under constant abuse for a long time. They are used for controlling automatic machines for signal systems, temperature control on all kinds of industrial equipment, and many other special uses. Single, double, triple and four pole, also single pole-double throw, and double pole-double throw types are available.

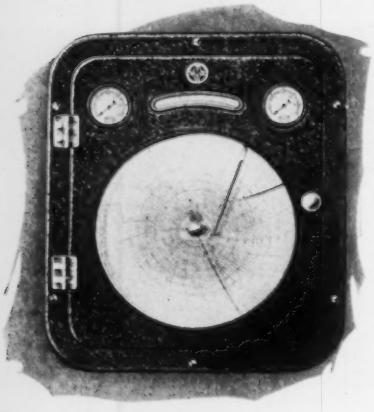
Solenoid windings are designed for continuous operation and can be controlled by any suitable single pole switch. No open arc is made because the current is broken by a mercury tube. The relay coils consume only a few watts and can be left in circuit with no possibility of burning out. Standard Type A or flush metal boxes can be furnished to enclose the relays.

◆ ◆ ◆

Compensated Temperature Controller

Mason Regulator Co.

THIS CONTROLLER not only controls the temperature by throttling the supply of heating or cooling medium, but it also compensates the pressure and resultant rate-of-flow of this medium. The result, it is claimed, is that heating or cooling medium pressure changes which would ordinarily vary the temperature being controlled are checked before the temperature has a chance to fluctuate. This anticipatory action insures temperature control of an accuracy heretofore unknown, it is said.



This new instrument has many other improved features such as: the compound balanced pilot valve which causes the diaphragm control valve to always maintain a "floating" position in accordance with the operating conditions, and dual helical temperature coils which provide a continuous positive check on each other. One actuates the control mechanism while the other inscribes a true chart record.

The instrument's ease of adjustment and unit construction, it is stated, enable the average plant operator to easily adjust or repair this instrument.

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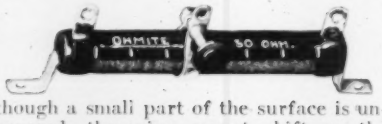
New Semi-Variable Resistors

Ohmite Manufacturing Co.

IN THESE resistors a percentage-of-resistance scale, which is marked on the side of the unit, permits setting the adjustable lugs to the desired resistance without complicated meter readings.

These semi-variable resistors are of the vitreous enameled, porcelain tube type. The resistance wire is wound around an Isolantite tube and covered with vitreous enamel. A narrow strip along one side of the unit is left exposed so that contact may be made at any point by means of adjustable lugs. Even



though a small part of the surface is uncovered, the wire cannot shift on the core because the under side is firmly imbedded in enamel. And, as over four-fifths of the surface is covered, the unit is protected from both mechanical and electrical injury. Contact is made on the exposed strip by buttons on the adjustable lugs which make a point contact and do not "short out" any appreciable amount of resistance.

"DIVIDOHM" units, as these resistors are called, are made in three sizes, 2 in., 4 in., and 6 in., which are rated at 30 watts, 55 watts, and 75 watts respectively. The resistance values range from 1 ohm to 100,000 ohms.

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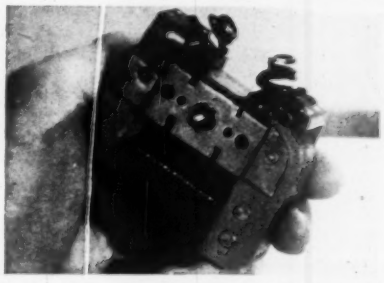
Reversible Shaded Pole Motor

Barber-Colman Co.

CALLED the Barcol Midget Motor, a fractional horsepower single-phase induction motor of the shaded pole type, is now made available in a reversing model by this company. Unidirectional models previously announced have made use of shading rings to introduce a delay in part of the field surrounding the rotor and thus to obtain a rotating field which would produce motor action. This new reversing model employs shading coils in place of the shading rings of the other models, and the motor is connected with current on the main field coil all the time, no rotation being produced until a current is sent through one or the other of the two sets of shading coils. Direction of rotation is determined by which of the two sets of shading coils is energized.

The construction of this reversing motor is much the same as the other models, with the exception of the wound coils which are used in place of the solid copper rings. These coils are made the same



as the main field coil, of high grade enameled wire on a phenolic resin spool and impregnated with moisture-proof varnish. The leads, as can be seen in the illustration, are brought out to plates mounted above the coils, and control leads as required are taken off from these plates. In all other respects—the main field coil, the field laminations and stator construction, the construction of the rotor, the type of bearings used, the bearing plates, and the method of assembly—the reversing model is identical with the unidirectional type.

The reversing model, like the others, is said to have high starting torque, high power considering the size of the motor, and relatively high efficiency. This model is available in several sizes to suit various applications and will be found useful in such devices as damper controllers, valve motor-operators, heat regulators, automatic switches, etc.

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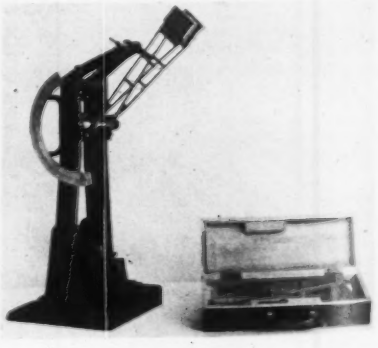
Miniature Impact Tester

Testing Machines, Inc.

THIS "miniature" impact machine is a standard ASTM impact tester for plastic molded materials. It is a new machine built to conform to the A.S.T.M. specifications D-256-28T and may be had for either Charpy or Izod systems or, if desired, for both. The standard range is 0 to 2 ft.-lbs. and each scale division is .01 ft.-lb. The scale reads directly in energy absorbed by the test specimen. Where individual requirements make it necessary, the tester can be had in a smaller or larger range than the standard 0 to 2 ft.-lbs. Further, more than one range can be provided if desired. This machine takes a Charpy specimen size ½x½x5 in. and an Izod specimen of ½x ½x2½ or 3 in.



New Extensometer

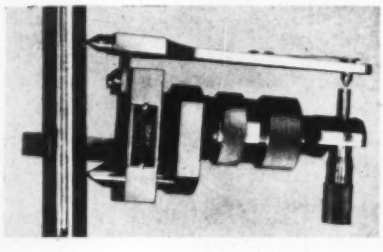
Linde Air Products Co.

CALLED the Oxweld extensometer, this new testing device makes it possible to determine the yield point of specimens being tested in an Oxweld portable tensile testing machine.

The sensitivity of the Oxweld extensometer is such that it will indicate the elongation in a standard A.S.T.M. test specimen occasioned by the heat of the human hand. Although highly sensitive, this precision instrument is simple, rugged, self-contained and self-compensating.

The two points of the Oxweld extensometer are clamped on the specimen to be tested in such a manner that the elongation between the two points during tension is multiplied in a ratio of 5-to-1 by a lever bar making electrical contact with the micrometer head. The moment of contact is indicated by the flash of a small electric light in the extensometer head. This exclusive feature makes it possible for a single operator using the Oxweld portable tensile testing machine in combination with the Oxweld extensometer to determine both the ultimate strength and the yield point of a specimen.

It is recognized by the American Society for Testing Materials that an elongation of 0.01 in. in a 2-in. gage length indicates the yield point of many materials including structural steel and mal-



leable iron. To determine the yield point with the Oxweld extensometer it is only necessary to back off the micrometer head two complete turns (0.050 in., which allows for the 5-to-1 ratio in the lever bar) from the zero reading (the point at which electrical contact is broken) for the specimen and apply the load, increasing the tension until the light flashes. The flash indicates that the yield point has been reached, and this may be read from the load indicating device on the tensile testing machine.

The extensometer may also be used as a strain gage to determine the elongation of a specimen under a specific load.

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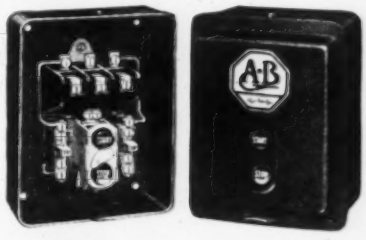
Hand-Operated a.-c. Starting Switch With Overload Protection

Allen-Bradley Co.

A NEW, compact, manually operated switch that will start and stop small a.c. motors and give overload protection has been developed by the above company. This new switch has two overload relays. The tripping of either relay opens the contactor and completely disconnects the motor from the line. Either relay, after tripping, can be reset without opening the switch cabinet. The switch is closed and opened by means of two operating buttons extending through the cabinet cover. Pushing in the "Start" button closes the contactor and starts the motor, and pushing in the "Stop" button opens the contactor. The cabinet cover can be padlocked shut, and a simple safety lock permits the switch to be locked in its open position.



Double-break silver-to-silver contacts eliminate the need for flexible connectors and reduce maintenance of the contacts.

This switch is made in two sizes. Size 1, which is the smaller, has three poles, and Size 2 has three and four poles.

The Size 1 switch will handle self-starting single-phase motors up to 1 h.p., 110 volts, and 2 h.p., 220 volts, and polyphase motors up to 2 h.p. at 220, 440 and 550 volts. The Size 2 switch is rated at 5 h.p., 220 volts, and 7½ h.p., 440 and 550 volts, for 2 and 3 phase motors.

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Combined Vapor-Pressure and Temperature Control Cabinet

Freas Thermo-Electric Co.

A NEW TYPE of cabinet has been devised by the above company to provide facilities for control and constant maintenance of vapor pressures, humidity, and temperatures, at any values required within a wide operating range—permitting processing and observations of effects to be made under controlled atmospheric conditions.

They are applicable for experimental and routine work wherein it is desired to maintain a controlled condition of heat and humidity; for biological investigations where an environmental control is required to study the growth and development of various organisms; as an accelerated aging cabinet for testing the life of various materials, such as paints, packing of foodstuffs and other materials under rigorous climatic conditions; as a fermentation and proofing cabinet in flour testing and cereal laboratories; and for incubation, and other purposes that will suggest themselves, which necessitate the precise control of atmospheric conditions.

The cabinets are complete self-contained units, fully equipped with regulators, heaters, and other devices to effect control of both dry- and wet-bulb temperatures, and vapor-pressure conditions. A standardized series of sizes is offered. Standard cabinets will maintain dry-bulb temperatures from 5° above room to 150° F., where heat absorption by the material is not excessive and wet-bulb temperatures over approximately the same range. The vapor pressures that can be maintained, range from a minimum of 0.5 in. up to 4.5 in. of mercury above the atmospheric vapor pressure, or an absolute humidity from about 20 grains up to 850 grains per pound of dry air.

In cases where it is desired to provide conditions less than atmospheric humidity, dehumidification and cooling apparatus can be furnished as a part of the equipment. Modifications of standard apparatus can also be provided in cases where greater heat capacity than usual is required.

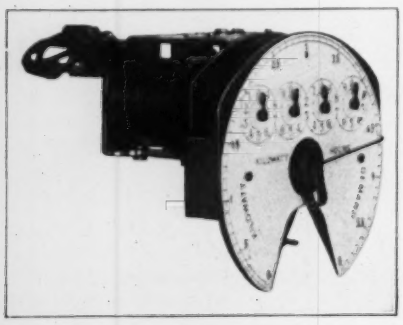
Humidification is accomplished by means of an injector atomizing a water spray or by introduction of steam, the admission of water or steam through the nozzle of the injector being controlled by a wet-bulb thermo-regulator actuating electrically-operated valves, thus effecting control of the wet-bulb temperatures.

A system of propelled air circulation or heat transfer by mechanical convection is employed which, it is stated, assures an even heat and vapor distribution throughout the chamber. It is produced by a motor-driven fan. The air is preheated and moistened before entering chamber, thus conditioned air passes continuously through the chamber the rate of flow being definitely controlled, and directed through suitable vents and air passages.

New Watthour Demand Attachment

Westinghouse Elec. & Mfg. Co.

THIS NEW type DR watthour demand register combines the regular watthour meter register with the scale and pointers of an indicating block-interval demand meter. By replacing the register and cover of a standard single-phase or polyphase OB watthour meter with this new register and special cover, the type OB meter is converted into an indicating, block-interval, demand meter. After this change has been made, the meter will indicate the maximum kilowatt demand and the integrated kilowatt hours.



This demand register may be used wherever the indicating type of demand meter is satisfactory. Smaller power installations, where investment does not permit the use of the more expensive recording demand meter, offer the most frequent applications.

The synchronous operating motor of the new type DR demand register has been improved over previous forms, and the reset mechanism, which previously operated by gravity, is now operated by means of a spring, a method better suited to resetting long scale demand registers. The improved synchronous motor not only measures the time interval but at the same time stores energy throughout the entire period by winding up the operating spring. At the end of the time interval the spring is released, restoring the demand mechanism to the zero position instantaneously without demeshing any gears.

The special glass cover complete with reset device is somewhat deeper than the usual cover, in order to provide room for the demand register.

These attachments with an adapter bracket can be used to convert standard OA watthour meters into demand meters.

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New Apparatus for Testing Hardness of Film Surfaces

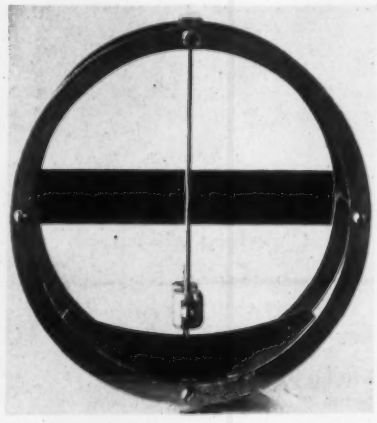
Institute of Paint and Varnish Research

IN FORMULATING new type protective coatings and studying existing types, it is often desirable to determine the hardness of a film. There are various types of apparatus which have been used for this purpose, among the most simple types being the swinging beam. That apparatus, however, has several disadvantages, some of which are the relatively long time required for a determination, its sensitivity to slight drafts, its unwieldiness, the use of a separate scale, and the calculations required. All of these objections are eliminated in a device recently perfected at this laboratory. This device, in action, is similar to the swinging beam, in that it rocks upon a surface. The harder the surface, the longer the device will rock.

This new apparatus takes the form of a pair of circular rockers with a pendulum pivoted at the top between the rockers. As the rocker oscillates from side to side, the pendulum indicates the amplitude of the oscillations. The rockers are flat bronze rings 4 in. in diameter and spaced 1 in. apart. The peripheries of the rockers are turned down on a radius of 0.5 mm.

At the top of the device, the pendulum is mounted on pivot bearings. The lower end of the pendulum terminates in a pointer which is 3⅜ in. long, and swings across a scale as the rocker oscillates.

The scale is marked arbitrarily at the point where the rocker completes its fiftieth complete oscillation on glass. It could be graduated in angular degrees, but in the manner described the calculations are made much simpler. Glass as the standard becomes 100 per cent by multiplying the 50 oscillations by 2. Values for other materials then are expressed directly in per cent by multiplying the number of oscillations on their surfaces by two.



The film whose hardness it is desired to determine is prepared on plate glass. The rocker is set on the film and leveling adjustment made so that the pendulum coincides with the center mark. The rocker is then rolled to the left until the pendulum just touches the left stop. It is then gently released and the number of times the pendulum returns to the left as far as the line on the left side of the scale is counted. Counting is begun after the last contact of the pendulum with the stop.

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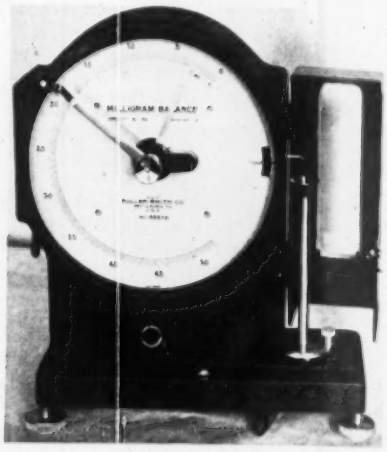
Precision Assay Balance

Roller-Smith Co.

A PRECISION assay balance that will, it is claimed, permit a hundred weighings in a half hour or less in skilled hands has recently been put on the market by the above company. Its general appearance and design are illustrated in the accompanying photograph.

The hinged door is swung open, the button placed in the little "V" shaped pan at the right and the door closed to keep off drafts. The index lever is rotated until the balance pointer comes to zero. The index pointer then indicates the weight of the sample, the value being read directly in milligrams on the dial. The beam is damped so there is hardly any overswing. The whole operation of placing the sample, obtaining a balance and reading the results is so simple that speed is claimed to be limited only by the operator's ability to keep moving.

The photograph shows a funnel and tube located below the "V" pan in such a way that the button, after it is weighed, can be shoved off the pan and it will drop through the funnel and out the end of the tube shown below the base of the balance. Any convenient receptacle can be placed at the outlet to receive the button. Many other accessories of similar nature are available. Accuracy is determined by the range of balance selected. This, in turn, is determined by the weight of the largest sample to be measured on the balance. Check weights can be supplied with certification either by the manufacturer or by the Bureau of Standards. While the application to assaying is new, this type of balance has been produced for many years and many are in use in other industries.



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Improved Beating and Freeness Tester

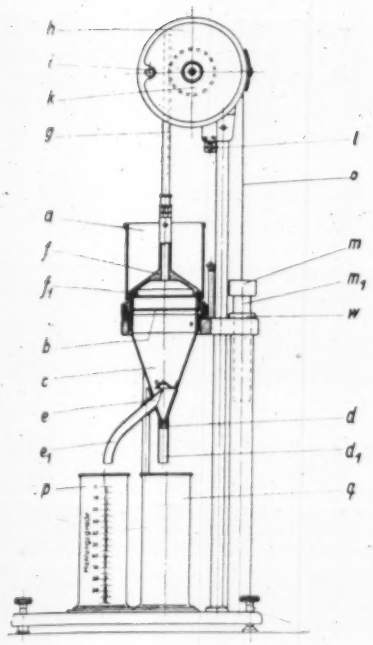
Testing Machines, Inc.

IN THE manufacture of paper, the pulp, consisting of water and fibers, is put on a mesh through which the main part of the water drains off immediately at lower or higher rate. The rate of drainage depends upon the condition of the fibers, their kind, fineness and soaking state, and upon the quantity and condition of fillings, glue, etc., added to the pulp.

The more the fibers are worked up mechanically, i. e., the more they are reduced by beating, calendering, crushing, etc., the lower the rate of drainage of the water. Thus, the rate of drainage allows us to infer the state of reduction or the degree of beating given to the pulp.

The quality of paper to be made depends to a large extent upon the degree of beating imparted to the pulp.

A pre-arranged quantity of pulp is mixed with 1,000 cc. of water at 18° to 20° C., and the whole is poured on a wire mesh 100 cm.² in size. The quantity of water passing through the mesh and through the pulp film forming upon it is



collected and led into two different measuring vessels, so that the water of quick drainage, before the pulp film is formed, flows into one beaker, whereas the later slowly dropping water runs into the other vessel. The vessel containing the quick draining water only is used for reading off the testing result. It is provided with two graduations, the one divided into 100 points (zero at the top), indicating the beating degree, and the other (zero at the bottom), showing in cc. the quantity of quick drainage water, i. e., the freeness or drainage capacity.

The earlier beating and freeness tester has been recently equipped with an additional contrivance. The conical valve, which previously was lifted by hand, is now actuated by a mechanical lifting device for obtaining testing results of higher uniformity.

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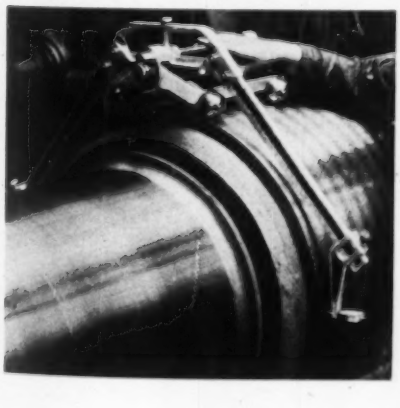
Indicating Caliper

Farrel-Birmingham Co., Inc.

DESIGNED primarily for the testing of large rolls used in paper calendars, sheet metal mills, rubber mills, etc., this caliper can be moved along the length of a roll and frequent measurements of its diameter quickly taken to an accuracy of 0.0001 in.

Unique features of this device are that it can be quickly adjusted for a wide range of roll diameters; a dial gage indicates the measurement directly, conveniently; there is no chattering in moving the caliper from one point on the roll to another.

It is claimed for this caliper that roll diameters all along the roll's length can be read so much more quickly and easily than by steel tape or micrometer, that it becomes feasible to calculate exact diameters required at frequent points on the roll, and to insure desired crown by checking the calculated diameters with the indicating caliper.



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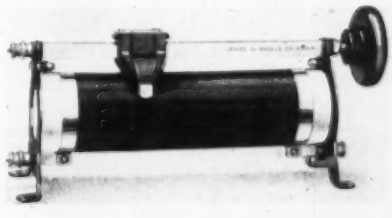
Improved Rheostats

James G. Biddle Co.

AS IN earlier models, this resistor uses a solid wall glazed porcelain tube on which the resistance wire or strip is wound. Features added in the improved resistor are:

A molded bakelite sliding saddle carries the sliding-contact brushes, and adds to the resistor's appearance, and ruggedness. One-piece supporting brackets, made of pressed steel, may bend in case of accident, but will not break. Terminals are mounted on the supporting brackets instead of on the end bands which tended to loosen with normal use. A new design of screw-driven fine adjustment—built in, out of sight and protected, as shown in the illustration, can be operated either way, i.e., by turning the crank for fine adjustment or, when desired, by moving the slider by hand in either direction without operating any latch or similar device.

These rheostats are available in several sizes, several types of winding, and for many current and resistance ratings.



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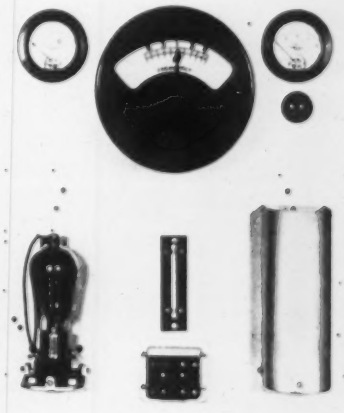
Visual Indicating Frequency Monitor

Doolittle & Falknor, Inc.

THIS device is designed to provide an immediate and accurate indication of deviation of frequency from a broadcasting station's assigned value, as a means of complying with Federal Radio Commission General Order 116. Visual indication of frequency deviations are indicated continuously on a switchboard type Weston meter. The scale is calibrated in two cycle steps from a center zero position. One-cycle deviations can easily be read.

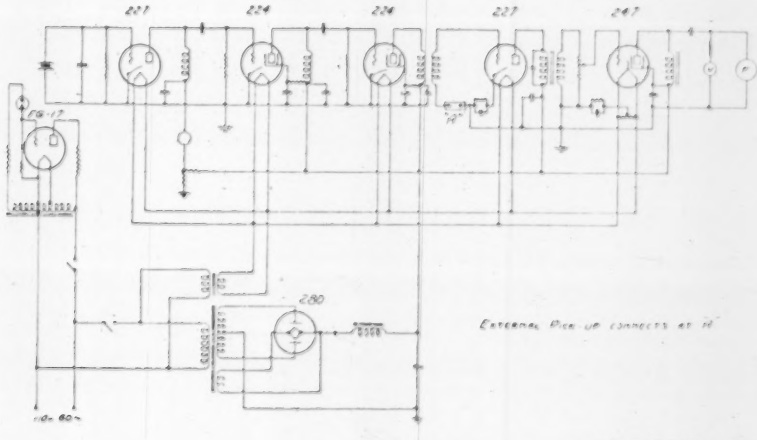
The temperature controlled chamber is maintained at a substantially constant value by means of a mercury column thermostat and a thyratron or grid glow tube for heat control. The plate circuit of this tube is used to provide the heater current, thus eliminating all relays and mechanically operated contacts. There are no moving parts in the entire device except the mercury column thermostat.

The crystal supplied is ground to a frequency 500 cycles different from the frequency to be checked. Power from the standard frequency crystal is fed to a detector tube through two screen grid "buffer" stages, thus completely isolating the crystal standard from reaction from the transmitter. A small "pick-up" coil is provided with which a small amount of power is introduced into the detector circuit. The result is a beat note of approximately 500 cycles which is fed to a large open scale Weston frequency meter calibrated in two cycle steps from zero to plus and minus 50 cycles.



Since this device employs a frequency meter of standard design instead of depending on a combination of vacuum tube voltmeters and resonant circuits, the accuracy is dependent upon the standard crystal and the frequency meter only.

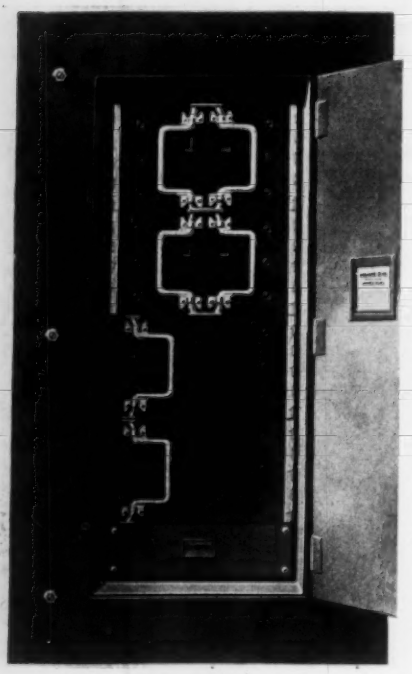
An a.-c. voltmeter is provided so that it is possible to adjust the voltage fed to the frequency meter to a constant value, thus eliminating errors due to aging of "buffer" and detector tubes. Provision is also made for quickly correcting any possible drift occurring over a long period of time. This monitor is completely a.-c. operated, no batteries of any kind being used.



Shallow Type Safety Panel

Square D Company

THIS new line of shallow panels employs cabinets only 6 in. deep and 19 wide which can be supplied for flush or surface mounting. One of the main features of the new line is the fact that combination panels, including regular



Square D Bakelite lighting panel sections can be built up for such applications as service stations, where a combination power and lighting panelboard conserves space and reduces installation costs.

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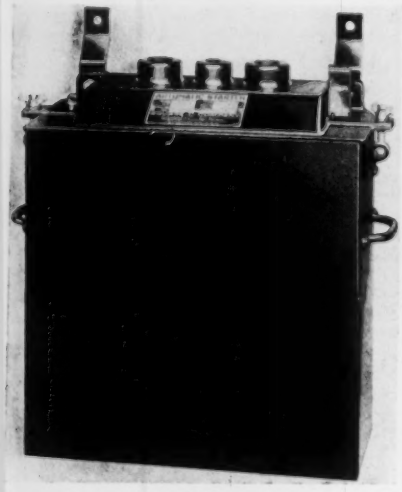
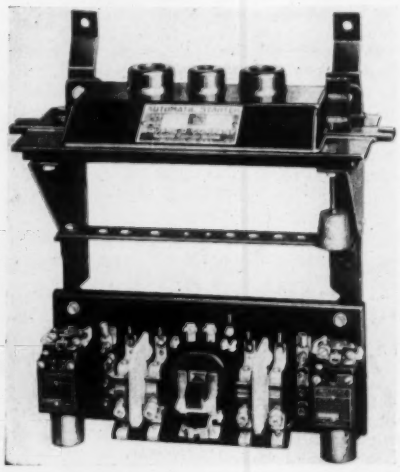
Explosion Proof Starter

Square D Company

THESE automatic a. c. starters are of the explosion-proof type approved by the Underwriters' Laboratories for use in Class I, Group D hazardous locations. They are oil immersed starters for across-the-line single and polyphase motors for application in locations where explosive atmospheres are present.





The explosion proof starter consists of a cast iron head, welded steel tank and starter panel. The head casting, which is provided with brackets for wall mounting, supports the steel angle frame to which the starter panel is secured and the oil tank. The panel consists of a three pole magnetic contactor and two oil dashpot overload relays. A visible gage indicates the maximum, normal, and minimum oil level in the tank. The oil, in which the terminals and electrical parts are immersed, will prevent an arc passing to the surrounding fumes and gases.

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New Circuit Protectors

Westinghouse Electric & Manufacturing Co.

FOR circuit protection in buildings, industrial plants, in fact, wherever electricity is used—this device has been developed to perform the function heretofore left to carbon circuit breakers or fuses. It is known as the AB "De-ion" circuit breaker.

The "De-ion" breaker is so enclosed in a molded composition box that no live parts are exposed. A handle, like that of a switch, protrudes through the cover to provide means for manual operation and for reclosing the breaker after it has been tripped, but the remainder of the mechanism is entirely enclosed.

The operating mechanism is arranged to provide quick make and quick break. The contacts, which are trip free of the handle, are held in the closed position by a toggle composed of two sets of links, one of which is fulcrumed to the contact mechanism, and the other on a cradle beam pivoted on the frame at one end and latched to the trip mechanism on the other end. The trip mechanism consists of a bi-metal thermal unit calibrated to trip at 125% overload. On breakers of 50 amperes or more an additional trip of the magnetic type trips the breaker instantly on short circuits.

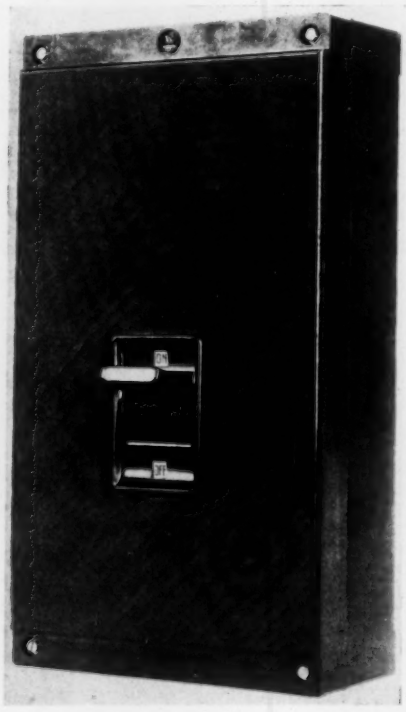
Upon being released by the trip mechanism, the cradle beam moves, permitting the toggle linkage to break and the contacts to open at high speed.

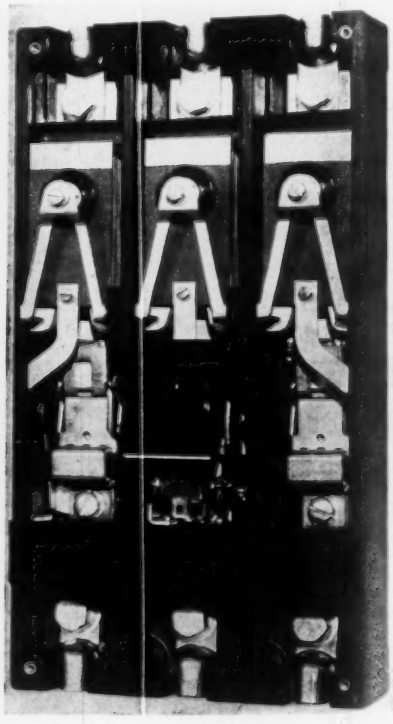
When the contacts open the arc is drawn through a series of small parallel plates 1/16" apart. Between the plates a radial magnetic field is created by a near by coil. The arc creates another magnetic field which moves the arc into the radial field. The plates absorb so many free ions that the arc is destroyed.

The use of "De-ion" breakers reduces the size of switchboards. A 600-ampere "De-ion" breaker occupies a space 8½ in. wide, while a 600-ampere carbon breaker requires a space 22 in. wide.

The 15 to 50-ampere breakers will be available in 1, 2, and 3 pole combinations, 125 and 250 volts. The 55 to 600-ampere breakers will be available in 2 and 3 pole combinations up to 575 volts.

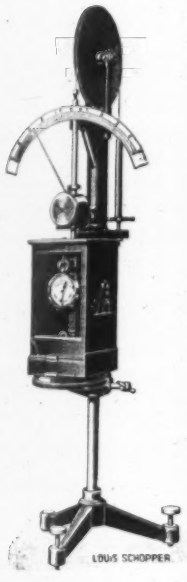
The new "De-ion" breakers will be inspected and labelled by Underwriters' Laboratories.





Tester for Moisture Shrinkage of Paper

Testing Machines, Inc.



STRETCH of paper when moistened and its shrinkage when dried are important considerations in multi-color printing since alterations in the size and shape of the sheet between printings will put the various colors out of register. To enable the paper manufacturer to produce paper in which these variations are minimized, the improved apparatus illustrated was developed from an earlier device.

The new apparatus is equipped with a copper cabinet. The top of the cabinet is permanently affixed to the upper grip of the tester. The rest is attached to the stand. By raising or lowering the stand the test strip is enclosed by the case or exposed, as the case may be. At the bottom of the copper case is a small drawer or till, in which is set a small glass bowl which may be filled with water. Just above the drawer is a sliding partition by means of which the upper part of the chamber in which the test strip is located may be shut off from the lower part in which the water is. A hair hygrometer hangs on a hook attached to the upper grip.

To obtain any desired humidity in the cabinet where the test strip is exposed, remove the partition, allowing the water vapor to rise from the drawer below, until the desired humidity condition is indicated on the hygrometer. Then close the partition and allow the paper test strip to come to hygrometric equilibrium. The tester is then set in operation and will indicate the effect of that humidity condition on the paper.

Similarly, by the use of a deliquescent powder, the air in the testing chamber may be dried out and the effect of a more dry atmosphere on the paper may be studied.

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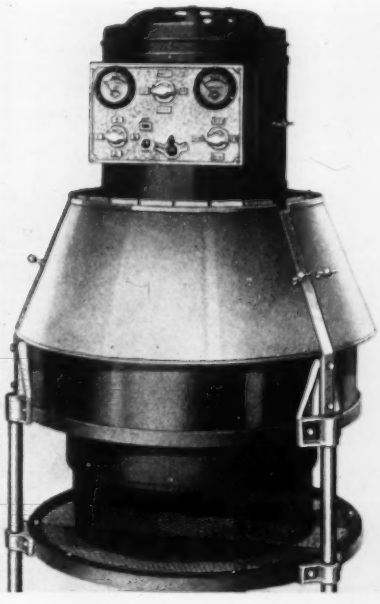
Improved Fade-Ometer

Atlas Electric Devices Co.

THIS testing machine, with improved control of voltage, temperature and humidity, is designed to meet the testing requirements attending the present high standards of color fastness of such materials as textiles, paper, inks, etc.

An artificial sun is reproduced in the Fade-Ometer by a violet carbon arc light. The specimens to be tested are exposed in holders arranged in a circle around the light. Ventilation is maintained and temperature kept within limits by an



electric fan. Humidity is furnished by a water reservoir placed below the specimen chamber.

An aluminum shell, hinged at six points, encloses the specimens which are placed in metal holders. These holders are suspended from a 20 in. ring surrounding the arc. This arrangement precludes the possibility of the specimens overheating by contact of the holders with other metal.

The water reservoir of polished copper, 29 in. in diameter, forms the base of the machine and serves as a humidifier. A series of wire frames in the reservoir are covered with cotton wicking. These frames rest in four inches of water and provide 1600 sq. in. of saturated wicking, through which all air coming in contact with the specimens is driven by an electric fan, placed below the reservoir. A relative humidity of 52% to 60% is produced.

The fan is controlled by a DeKhotinsky Thermo Regulator, making it possible to maintain the temperature by automatically starting and stopping the fan. A voltmeter is provided for reading the arc and line voltage and an ammeter for ascertaining that the proper amount of current is consumed. The rotary main line switch and two four-point adjusting switches make it possible to control the arc to a very fine degree. The apparatus is made in one size only, capacity 42 specimens.

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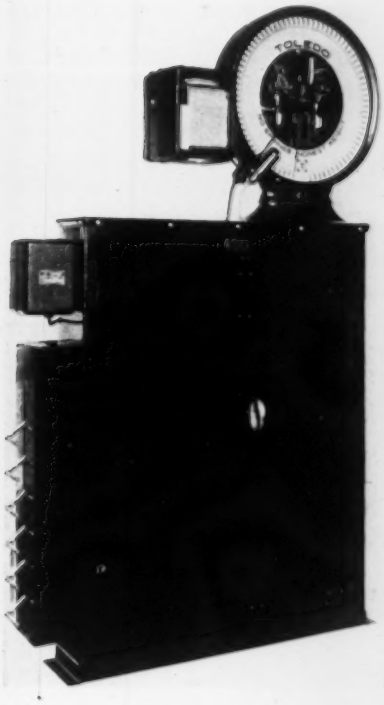
Automatic Batching Equipment

Toledo Precision Devices, Inc.

THE NEW automatic batching equipment, recently developed by this company, reduces the batching of materials to a simple cycle of lever and button operations which can be performed by unskilled labor. This new assembly consisting of a Toledo scale equipped with a photoelectric tube, a lever system and a set of beams, makes the batching operations practically automatic.

The tank or hopper where the batching takes place is mounted on a special assembly on the scale platform. There is a set of beams, one for each ingredient



which enters the mix. These beams are regulated by a system of hand levers on one side of the scale. Buttons control the starting of the flow of materials. When the desired weight has been placed on the scale, the photoelectric relay stops the flow. Attached to the head of the scale is a graphic recorder. This provides a checking record for every ingredient which enters the tank, and hence a constant guard against mistakes.

Operation of the equipment is as follows: Each beam is set for the correct amount of the ingredients which are to enter the mix. Once the beams are thus set, the operator turns down the first handle, which throws the beam for the first ingredient into the lever system. He then walks on the other side of the scale and presses the button for that ingredient. This starts the flow of material. While walking from one side of the scale to the other, the indicator has sufficient time to come to equilibrium. The first ingredient starts to flow into the tank, and the indicator starts to return to zero.

While this ingredient is flowing into the tank, a light beside the button burns brightly. When the necessary amount has entered the tank, this light dims. Hence, by glancing at these lights the operator can immediately tell how many ingredients have already been put into the mix, and whether any ingredient is flowing into the tank at that instant. The same operation is followed for each ingredient until the batching is complete. Afterwards, inspectors can check each batch by the graphic record which is provided.

Automatic Lighting Control

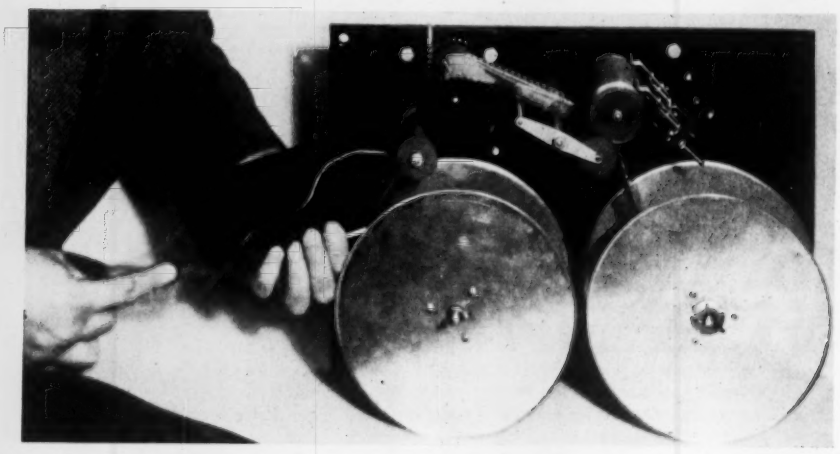
Westinghouse Elec. & Mfg. Co.

AN hour's program of changing lights, flooding Chicago's Buckingham Fountain at night, will soon be presented by an ingenious control based on thermionic tubes and a tape-like ribbon.

There are 23 circuits, and for each of them a long ribbon of fire-proof film, on which the predetermined program is laid out in copper braid. The film moves slowly over a roller wound spirally with resistance wire, and the varying position of copper braid controls the voltage on the control circuit. This slight variation controls successively 3 vacuum tubes, which actuate a 3-legged reactor which in turn varies the voltage on the lights. As no resistance is used in the lamp circuit, the energy saving is large.

To lay out a new program, the braid need only be sewed on the film in a different path, by an attachment used on a sewing machine.

Only the automatic control is new. The fountain itself and its lighting have been in use for some time, under hand control.



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Magnetic Inspector

N. A. Kurman

CALLED a magnetic inspector, this device is for the comparative test of magnetic material and apparatus. As such, it is a supplement to the permeammeter. It is claimed that by its use raw materials and specimens in finished form can be rapidly and accurately checked for physical properties, thermal history and chemical analysis. Coils can be checked for inductance, shorted turns, number of turns, opens and grounds. Adapted for a.c. operation, readings are direct, and repeatable. Though primarily a device for pre-test on the production line, it is used also in laboratories.

Essentially the device is a vacuum tube Wheatstone bridge. It contains an oscillator with seven different testing frequencies. A jack is provided for the purpose of operating the inspector from an external source. A voltage regulator serves to keep readings constant over a fair range of line voltage fluctuation.

A feature of this magnetic tester is its extreme sensitivity. Single laminations can be tested; it will show single shorted turns in coils; and finished apparatus can be tested for overall adjustment and characteristic. Readings are direct, and compared with a known, dependable standard.

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Photoelectric Relay

G-M Laboratories, Inc.

THIS NEW photoelectric relay embodies the unique feature of permitting all wiring to be concentrated at one point. This single unit combines the amplifier, photoelectric cell and light source within a single case, greatly simplifying the work of installation.

Another advantage of this type of unit lies in the fact that no separate and bulky light source is required. The rays from the lamp behind the right hand lens are focused on a special mirror, and reflected to the lens in front of the photoelectric cell. This mirror can in many cases be mounted in a space too small

to accommodate a separate light source, or in a location where it would be difficult to bring in special wiring to supply lighting current.

Many other unusual features are said to be embodied in this new unit. Removal of a small front plate permits ready adjustment. All wiring and interior parts are attached to a central section of the relay entirely independent of front and back covers. The case is of cast aluminum and so designed that the entire unit may readily be weather-proofed for outdoor use. In addition, this unit is capable of operating at speeds as high as 600 light interruptions per minute.

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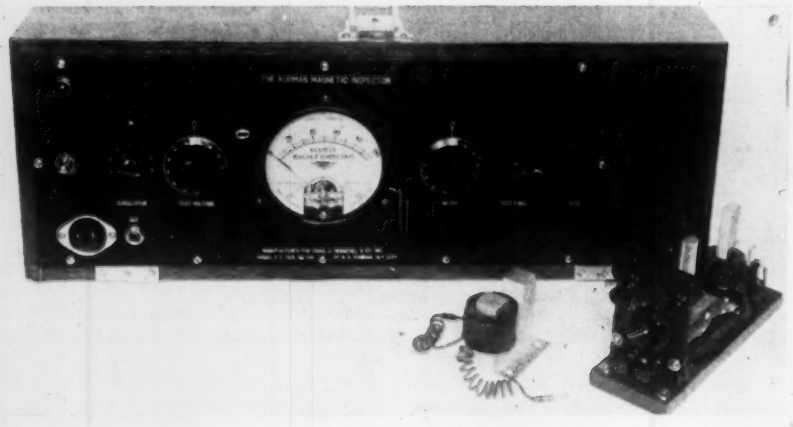
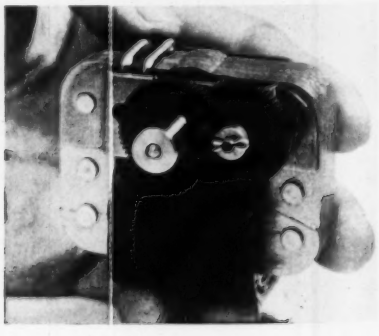
Geared-Head Motor

Barber Colman Company

THE SMALL shaded-pole induction motor which was recently put on the market by this company is now available in a geared-head model. This consists of a standard motor to which has been added a spur gear reduction. The unit will deliver a maximum torque of two pound-inches at approximately 100 r.p.m. The input required is 37 watts or less, depending upon which of the several models of standard motor is specified. This geared-head motor will find many applications in such devices as slow speed stirring machines, for winding up fairly heavy spring motors, etc.

The second, and final, driven gear has a fairly large hub in which is incorporated an oil-less bearing and this gear runs on the motor shaft itself. The two intermediate gears are mounted on a stud which is riveted into the frame plate of the motor. The driven device is to be coupled to the hub of the final driven gear, preferably with a flexible coupling. (This hub being fairly well away from the motor bearings, the motor is recommended for a torsion drive only.)

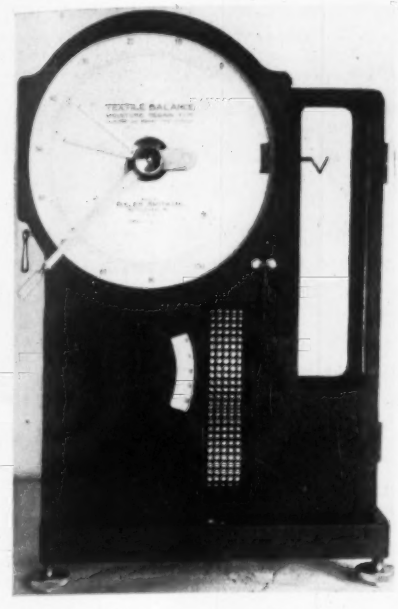




Balances for the Textile Industry

Roller-Smith Co.

TEXTILE materials are being generally evaluated on the basis of weight per unit length of the thread. Weight of thread per unit length is also often required in determining weight per yard of cloth, or weight of yarn skeins of standard length.



To take into account the effect of moisture on the thread sample being weighed, these balances can be provided with an auxiliary movement in the same case but independent of the main movement. The auxiliary movement is calibrated so that it reads zero when a weight of 100 mg. is on the hook. It reads directly any increase in this weight up to 20 mg. Therefore, a sample of the same material being studied is made to weigh 100 mg., bone dry. It is hung on the auxiliary hook and when dry indicates zero. It will regain an amount of moisture equal to that of the test sample, provided both are exposed long enough to the same atmospheric conditions. The reading of the auxiliary movement then indicates directly the percent of moisture in the sample. To calculate the weight bone dry or at any desired per cent is therefore a simple matter.

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Complete Line of Magnetic Switches

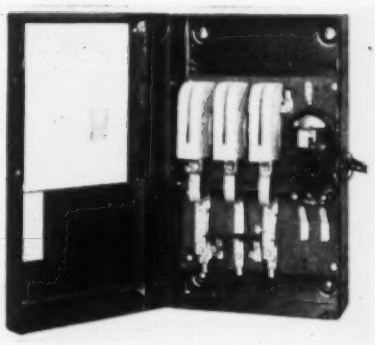
General Electric Company

THIS company's line of full voltage starters for squirrel cage induction motors is now complete for sizes up to 1200 H.P., all switches conforming to NEMA requirements. Size 2 and size 3 magnetic switches are now rated as follows:

Size 2: 15 H.P., 220 volts; 25 H.P., 440 and 550 volts.

Size 3: 25 H.P., 220 volts; 50 H.P., 440 or 550 volts.

The switches include the new thermal overload relays which follow more closely the heating characteristics of the motor than did any previous types. The relay heaters on the first four sizes are now interchangeable as regards the mounting



dimensions. The enclosing cases for the various switches are similar in appearance and all forms are available in cast iron or boiler plate case for installation in dusty or damp atmospheres. Any magnetic switch in the line can be obtained in form suitable for oil immersion where the installation atmosphere is corrosive. Explosion-proof switches, approved by the Underwriters, are available for Class I Group D hazardous conditions.

The General Electric line of combination switches using a magnetic switch and a fusible or non-fusible motor circuit switch has been augmented by a device rated 25 H.P., 220 volts, and 50 H.P., 440/550 volts. These combination switches use the same thermal overload relays that have been incorporated in the standard full voltage starters. Any of the combination switches can be obtained with test jacks, if required. All forms and sizes are available in cast iron, dust-tight cases.

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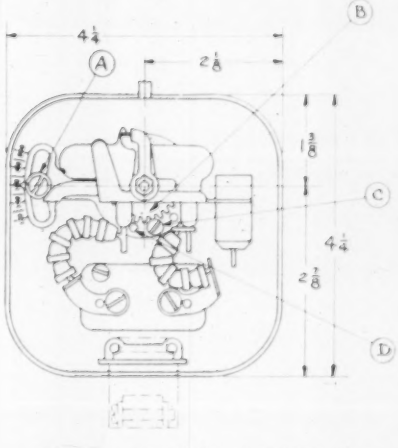
Water Heater Thermostat

Hart Manufacturing Company

THIS "Diamond H" Water Heater Thermostat marks a definite forward step in solving the control problems of water heater manufacturers. By the use of a cast bronze separable socket which is securely screwed to the tank, and to which the thermostat is mounted, it is not necessary to draw off the water from the tank in case of replacements.

The setting of the thermostat is so arranged that the control temperature may be fixed at any point between 120 and 200° F. When once set it will turn on and off at the set temperatures indefinitely.

It is easy to calibrate and equipped with terminals for easy wiring.

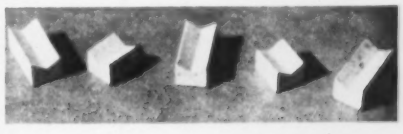


With cover off showing internal mechanism.

Scale Bearings Now Made by Extrusion Process

ACCURACY and extreme hardness are the prime requisites in scale bearings. The V-shaped groove in which rests the steel fulcrum must be extremely accurate for free and easy motion, while the block itself must be sufficiently hard to minimize wear. Heretofore, these requirements have been met with agate scale bearings, carefully ground to shape and then highly polished. Such bearings have been expensive, which has militated against their employment in the less expensive kinds of scales or balances.

Once again American ingenuity has come along to offset age-old tradition. Henry L. Crowley of West Orange, N. J., has developed a new scale bearing which can be produced at a surprisingly low cost. This bearing is made of crolite, a scientifically compounded material which, after it is fashioned to the desired shape and size, acquires rock hardness when fired at high temperature. For bearings, the raw material is continuously extruded from a die of the exact cross section desired. Desired lengths are then cut to form the blocks, and this is followed by precision firing to impart the proper hardness for the final scale bearings. Extrusion gives the bearings a velvety smooth finish, practically equivalent to the high gloss of polished agate.



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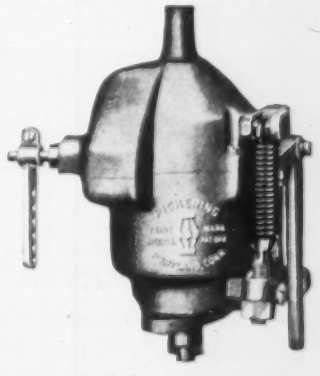
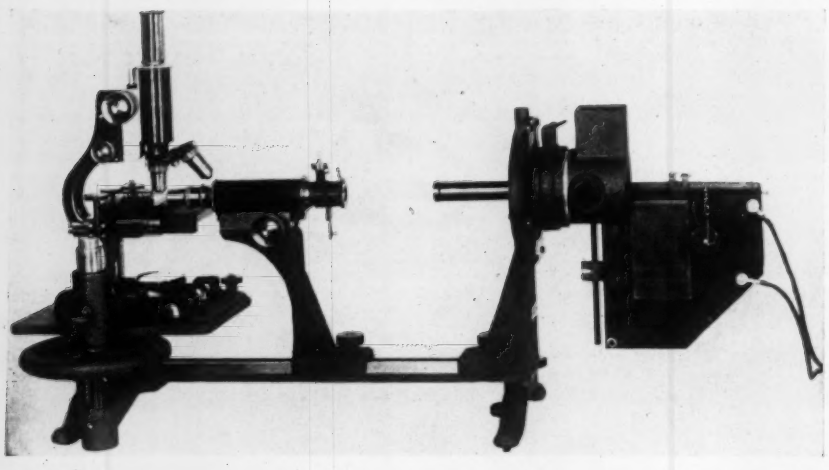
New Fuel Governor

The Pickering Governor Co.

IT is not good engineering to permit a governor to restrict the performance of a good engine at any point. The Pickering Governor Model G P is designed to meet any engine test. Because of its unusually effective action, at governor speeds of 12 r. p. m. or less, it will be found a particularly desirable governor for conditions where high engine efficiency and fuel economy are important factors. It has a wide governing range and gives extremely close regulation at any set point. It is particularly suitable for tractors and stationary power units that are required to operate at varying loads and speeds. Its speed changer may be operated from remote points; it is automatically lubricated; ball bearing equipped; has practically nothing to wear and "will outlast any engine," it is stated.





Unified Slit Ultramicroscope

Bausch & Lomb Co.

MANY of the materials about which we are constantly seeking information, are made up of particles so small that they are not visible in the usual microscope illumination—they are ultramicroscopic. Their presence is detected, and their size and number estimated, by the use of a powerful beam of light which strikes them at right angles to the axis of the observing microscope and is deflected, from the particles, to the eye of the observer. The unified slit ultramicroscope illustrated here may be used by chemists in research or industry for the study of any of the eight possible colloidal systems.

The instrument consists essentially of an illuminator, illuminating microscope, adjustable microscope platform and a newly designed three-way mechanical stage. Any compound microscope with a square stage may be used.

The optical bench is of one piece. At one end is mounted a clock-feed arc lamp with its condenser and centering screws. The condenser is permanently focused to image the crater of the arc on the slit of the illuminating microscope.

The illuminating microscope consists of an adjustable slit and an objective with rack and pinion motion for focusing the image of the slit in the colloidal medium. The stellite jaws of the precision type adjustable slit are controlled by a micrometer screw graduated in tenths of millimeters. The slit may be varied in width and length and rotated through ninety degrees. The length adjustment is controlled by a V slide. The rack and pinion allows the smooth, precise focusing of the cone of light formed by the illuminating objective.

The microscope platform has a vertical adjustment for alignment of the various heights of microscopes with the path of light.

Vertical adjustment to the extent of 3 mm., in addition to the usual calibrated horizontal movements, is provided in the mechanical stage, permitting a more complete exploration of a specimen.

A glass cell 2 mm. deep and 12 mm. in diameter is supplied for examining colloidal liquids. The cell is recessed in a special slide 5 mm. thick; it has a window fused on one side for the entering beam. In use the cell is covered with a conventional cover glass.

The usual microscope objectives and eyepieces are used for examining ultramicroscopic particles. A 10X net micrometer eyepiece for counting particles is provided. It has 18 squares each representing an area of 0.0005 mm.^{2} in the medium when used with a 4 mm. 0.85 objective. Consequently the slit ultramicroscope gives the approximate number of colloidal particles in a given volume, and some idea as to their size—often the most essential knowledge in attacking a problem.

One example of the problems which can be attacked with the slit ultramicroscope is filtration in the sugar industry. It is important to remove as much colloidal matter as possible at each filter press and the slit ultramicroscope offers the only way of checking up on the clear liquids, to determine whether all colloidal particles have been removed in the mechanical process.

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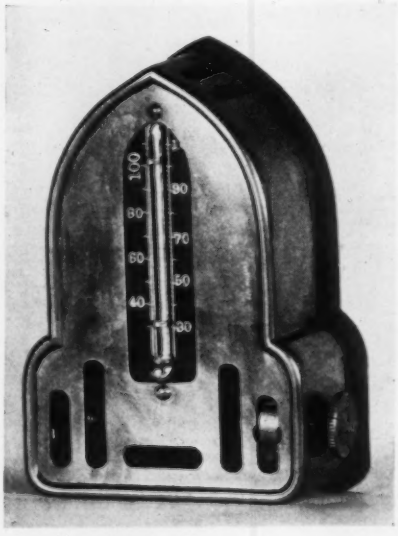
New Thermostatic Control for Motorized Devices

United Electric Controls Co.

ATTRACTING much attention throughout the oil burner industry among other fields of application, a new thermostat, designated as "No. 11," is claimed to be the [illegible] and compact, yet accurate, temperature control device ever built in its working load range. Its temperature range is 50 to 80° F. with *one-degree* operating differential. It furnishes line voltage direct control, for oil burners, stokers, blowers and all other motor operated devices where the working load does not exceed 10 amps. at 110 volts a.-c. or 5 amps. at 220 volts a.-c. or d.-c. Bellows-actuated, with snap-acting enclosed silver contact switch. Also furnished with 3-wire low voltage switch. Operates in any position and is unaffected by vibration.



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Rotameter

Schutte & Koerting Co.

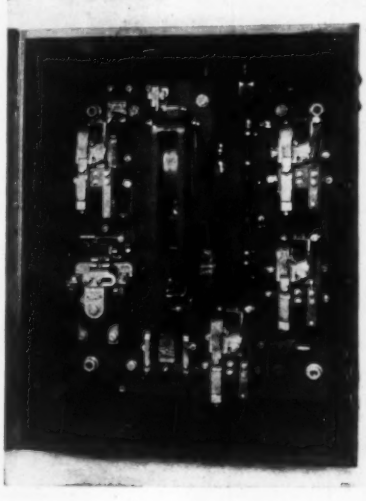
THE ROTAMETER is a non-recording instrument designed to show rates of flow in pipe lines carrying water, oil, chemicals, other liquids, air or gases. It consists of a simple frame on which are the inlet and outlet connections and on which is mounted a vertical, transparent tube having a tapered bore, with the small diameter at the bottom. This tube is protected by a polished guard. Inside the tube is a top-shaped float, held in suspension by the upward flow of the liquid or gas. The float is entirely free and as its special shape keeps it in the center of the stream, the action is frictionless. The annular space between float and tube increases as the float is carried up by increasing flow. The position of the float is therefore in direct relation to the flow. On the outside of the tube is etched a scale on which an exact reading of the rate of flow is shown at the point directly opposite the top line of the float. Rotameter readings are claimed to be correct within capacity ranges from 100% or full flow down to 10% of full flow. Rotameter tubes are readily accessible for cleaning.

New Non-reversing Time Limit Starter

Westinghouse Elec. & Mfg. Co.

FOR mining service for use with non-reversing, constant speed direct current motors on pumps, fans, hoists, all kinds of conveyors, loading machines and all types of mining machines, a new time starter has been designed by the above company.

By use of a recent development known as the "Timetactor," definite time limit acceleration is obtained without the necessity of intermediate relays. This gives a compact, simple and positive definite time limit method of accelerating a motor for the greatest voltage range for which a magnetic starter has ever been developed, it is claimed. The "Timetactor" will operate and cut out the accelerating resistor on any voltage which will hold the line contactor closed, due to the fact that the "Timetactor" is electrically opened and mechanically closed. One "Timetactor" is used for each step of accelerating resistance. The new heavy duty contactors provide a new and highly effective arc rupturing system which has a very high arc rupturing capacity and is said to reduce burning of contacts to a minimum. The high arc rupturing capacity provides short circuit protection for most mines.



Thermal magnetic overload protection provides inverse time tripping for moderate sustained overload and instantaneous tripping for severe overloads, grounds or short circuits. Either hand or automatic reset is available. The controller is so designed that it will operate over the widest variation in mine voltages on which any d.-c. motor can be operated satisfactorily. The starter will operate perfectly under conditions where the voltage before starting the motor is approximately 65% of rated voltage then dropped to 25% as soon as the motor starts. The limiting voltage before starting is that required to pick up and close the line contactor while the limiting voltage after the line contactor picks up is that voltage required to hold the contactor closed.

The starter gives instantaneous trip for severe overloads, has time limit acceleration and will operate over the widest possible voltage range. It is of compact design. The 75-horsepower, 230-volt, 4-step starter is mounted in a cabinet 19⅛ in. wide, 24⅞ in. high by 22⅛ in. deep.

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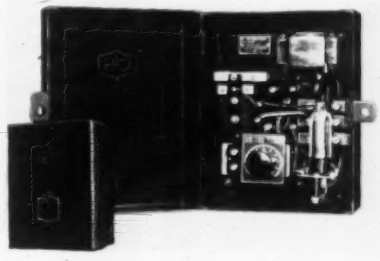
New Tube Timing Control for Welding Service

Cutler-Hammer, Inc.

PROMISING wide use in industry, this new timing device for spot, projection, and other forms of resistance welders is said to give extremely accurate timing control of the welding operation. Use of an electronic tube, it is further stated, makes possible accuracy to a very small fraction of a second and the device has an adjustable range up to 16 seconds.



This new tube timing welder control, known as Bulletin 13101, is said to eliminate all guesswork on the operator's part—enabling unskilled operators to produce successful welds and to practically eliminate rejects and throw-outs. The timing is adjusted by a knob inside the enclosing case. This new tube timing control requires a very small mounting space and operates on 110 to 550 volts a.-c., 25 to 60 cycles. Severe or intermittent service will not affect the accuracy of this control, the manufacturer asserts.

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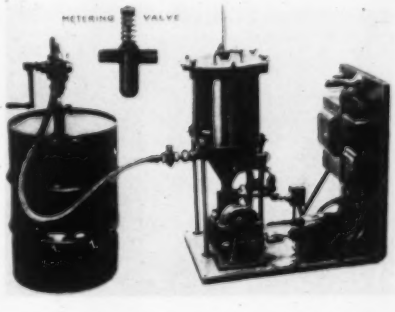
Single Line Multifeed System

Hills-McCanna Company

A SYSTEM for the mechanical application of light greases and heavy oils to points requiring regular lubrication rounds out this company's line of equipment for lubricating any type of machinery that requires regular amounts of oils and greases.

It is a single line system. The main unit is placed in a convenient location and a single feeder line taken to the farthest point requiring lubrication. Branch lines are then taken from the main line to each bearing. No return line is required. An independent mechanical measuring unit is placed at each bearing. The measuring valve allows only the amount of grease it is set for to be fed to the bearing, and then acts as a shut-off valve. Regardless of the amount of pressure in the line only that amount the valve is set for can pass to the bearing. There is visible evidence that the valve is operating.



An added advantage is that the pressure is applied to the line only at the time the points are being lubricated. No air, spring, or means other than a positive pump, are used to accomplish delivery. The systems can be motor-driven, mechanically operated, or operated by a hand crank. The type depends upon the service. The systems will handle all of the light greases and heavy oils in general uses. The Force Feed Lubricators will handle light oils and the Mill Type Grease Pump will take care of the heavy greases. All of the systems are pressure types, and based on the metering principle.

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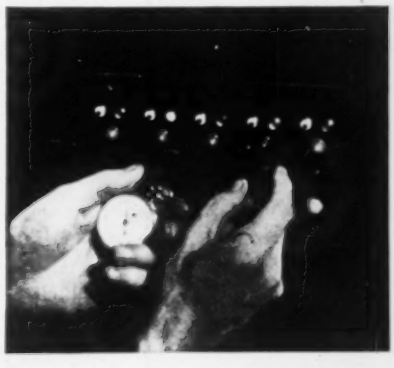
Polaricode Split-second Supervisory Control

Westinghouse Elec. & Mfg. Co.

POLARICODE, an entirely new supervisory control, is new in principle and is said to be setting a new standard of control speed. The "super speed" permits selection and operation of the control circuits of any piece of remotely controlled apparatus in less than one second. It is truly a split-second supervisory control. The exceptional speed is accomplished by a principle new to supervisory control known as "direct selection" which eliminates the loss of time inherent in previous selective supervisory systems operated by either coded impulses or by synchronous selection.



Polaricode is available for use on 2- and 4-line wires. The 2-wire type controls up to 25 remote apparatus units and the 4-wire type controls up to 2500 units—all at the same super speed. Both the 2- and 4-wire types permit a number of remote stations to be operated on the same two or four wires. In addition, remote metering and remote synchronizing may be obtained without the use of any extra line wires.

Polaricode is suitable for practically any application where supervisory control is required, such as the control of any type or size of remote station on power systems, electric railways, electrified railroads, oil line pumping, etc. Polaricode uses the same "all-relay" construction employed with previous Westinghouse designs and is composed of simple, mechanically uniform, telephone type relays similar to the ones originally used for supervisory control some eleven years ago.

New Motorized Draft and Temperature Regulators

Defender Automatic Regulator Co.

CLOSE and dependable control of pressure, draft, temperature and other conditions is obtained by means of a new line of electric motor powered automatic devices brought out by the above Company. Four distinct regulators, each of which may be adapted to suit the application, make up this new line. These are strong, powerful, supersensitive, quick acting regulators and with certain modifications and added attachments they can be made to do almost anything in control or regulation of vacuum, pressure, temperature, time, volume, flow, level, supply, etc. Close hook-up or remote control types can be supplied or many auxiliary long distance controls can be operated from one master control.

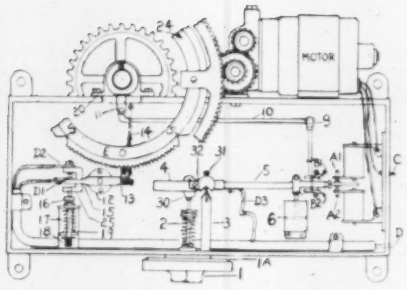
(1) *The Defender "Junior Model" Electric Furnace Draft Regulator* is applicable for low pressure air or gas regulation, and especially suited for furnace draft control of steam boilers. It works equally as well on forced draft stoker or oil or gas fired boilers. It is especially recommended to be used on all forced draft stokers that are equipped with an on and off automatic pressure switch to start and stop the stoker and fan motor as the steam pressure on the boiler varies. This regulator is 12½ in. long by 12½ in. wide and 6 in. deep. It weighs 20 lbs.

(2) *The Defender electric motor operated high or low pressure Damper Regulator* is actuated by the steam pressure on the boiler and equipped with an adjustable compensator so as to make the regulator gradually open and close as the steam pressure rises and falls. The regulator can be supplied with single or double lever or sprocket chain wheel. It will work on any vacuum up to 20 inches or any pressure up to 250 pounds by simply adjusting thumb screw on the bottom of the case.

It will function on one ounce change in pressure and can be supplied to make any number of stops from 1 to 16 on one pound change in pressure, or the adjustable Compensator can be adjusted to make it make any number of stops from 1 to 16 on any change in pressure from 1 to 10 pounds.

This regulator is assembled with all of the wiring and operating parts except the motor in a one-piece cast aluminum case, and the motor and gears with the crankshaft are mounted on the top of the case. There is a front protecting lid and a top dust-proof cap. We believe, states the maker, that this is by far the most sensitive pressure or vacuum regulator of the heavy duty type that has ever been designed. This regulator is 20 in. long by 12 in. high, by 6 in. deep. Weight 20 lbs.

(3) *The Defender "Senior Model" Electric Furnace Draft Regulator.* This regulator is especially designed to be used on boilers using forced draft that are equipped with the above Defender Compensating steam pressure Regulator (2) to control the forced draft fan speed, or a damper between the fan and stoker, or to control both the forced draft and the stoker speed or same will also function properly when used in conjunction with any of Defender Hydraulic Damper Regulators. It should be connected up to operate on the boiler damper when the steam pressure control is operating on the forced draft and stokerspeeds, or it can be connected up to function on the forced



draft fan speed or a damper between the fan and stoker, and the steam pressure control would then be connected to the boiler damper and the stoker engine or rheostat if stoker is operated by a variable speed motor.

This regulator is also especially suited to control the furnace draft by operating on the boiler damper of oil or gas fired boilers whether the oil or gas are hand regulated or whether they are controlled by the above electric steam pressure control (2) or by any Defender Hydraulic adjustable Compensating type Damper Regulators.

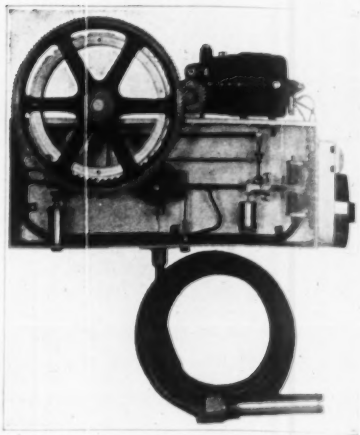
Referring to the diagram, Part No. 1 holds a thin diaphragm and is tapped on the bottom for ⅜-in. pipe thread. Spring No. 2 is adjustable to draw up on the diaphragm. The round aluminum circular wheel No. 24 has special type V notches filed in same for breaking the contact D2.

The motor is a 1/30th H.P. split field series wound reversing high-speed type with part of the reduction gears built into the same frame with the motor and four additional gear wheels on the outside as shown. With this reduction the speed is stepped down so as to give a very powerful pull on the drive shaft in the center of the large gear wheel, and also a slow movement of same. It can be set with adjustment plunger No. 16 in dash pot 19 so as to give a quarter-turn in either direction in from one minute for the fastest speed down to four minutes for the slowest speed, or we can supply other gear ratios that will make the regulator work as fast or as slow as is required. Limit switch (B1 and B2) prevents any over-travel of the motor in either direction so as to allow the center shaft of the large gear wheel to make only a quarter-turn.

Where a regulator is desired that will make several complete turns of the drive shaft in the center of the large gear wheel, we can supply a different type attachment in place of Nos. 11 and 10, and then a small sprocket wheel can be used at the back, and the chain can then be made to travel any distance from a fraction of an inch up to 20 inches, and has equal pulling power in both directions.

The small very light and sensitive compression spring No. 2 rests on top of the cast aluminum case and has an adjustable round form screw plate on the top of the spring and screws up or down on the small vertical rod which is attached into the center of the diaphragm at the bottom and is screwed into the bottom of the fitting No. 30, which has the knife edge fulcrum bearing mounted into the top of same to hang onto the horizontal cross arm No. 4.

There is a safety cut-out on each end of the quarter turn of the regulator. These are marked S on the round cast aluminum circle No. 24. Should regulator over-travel for any reason, the wheel above, 13, will be pulled by spring 14 into this deep set V marked S and this will pull the contact breaker arm D1 down so low that the top contact maker D2 cannot come down far enough to touch the lower contact because the piston inside dash pot No. 19 will rest on the bottom at No. 18, and the unit will then have to be started by hand by pulling down on No. 13 and the motor will then reverse and get back into operation.



(4) *The Defender Electric Motor Operated Temperature Regulator* is especially designed for heavy duty purposes to control any number of inlet or outlet butterfly, balanced or slide dampers, or any type of lever valves, or both, to maintain even or gradual increased or decreased temperatures on any liquids in open or closed type stills, vats, heaters, boilers, tanks, cookers, condensers, melting pots, evaporizers, etc., by opening or closing hot or cold supply line or Oil or Gas Burners, etc.

"It will function on from 1 to 2 degrees change in temperature and will work on any temperature up to 800 degrees. . . . This temperature Regulator will operate on any temperature from 1000 degrees down and is set for the given temperature by turning a screw at the bottom of the case." 25 feet of tubing is standard, and standard bulb as illustrated is 1 in. diameter and 5 in. long. The hub is detachable. Bulbs with separate outer protectors can be supplied. "A change of temperature along the tubing or in the regulator itself around the coil spring will not affect the accuracy of the control as the bulb holds several thousand times more gas than the tubing and coil spring both put together."

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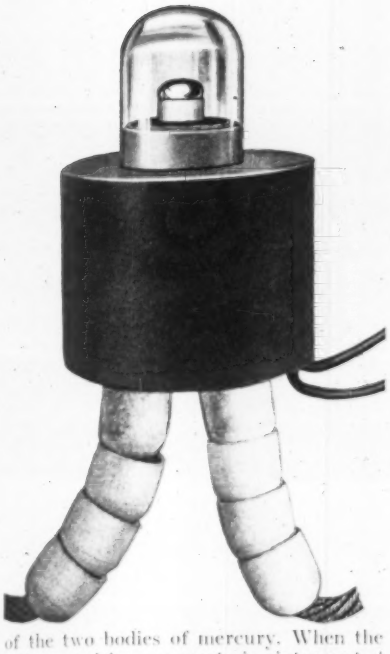
Magnetically Operated Mercury Switch

Providence Electric Controls, Inc.

THE "Magnetrole" switch illustrated operates entirely through magnetic action and does not require moving or tipping. Within the glass tube or envelope is placed a ceramic member so arranged that two separate pools of mercury exist. Floating upon the outer mercury pool is a displacement member of magnetic susceptibility. When the coil surrounding the tube is energized, the displacement member is drawn down, thereby causing a rise in the outer pool level which results in the merging



of the two bodies of mercury. When the coil energizing current is interrupted the floating piece immediately returns to the top thereby separating the two mercury pools with a resultant break in the switch circuit. The arc occurs around the edge of a ceramic tube which is well separated from any other part of the switch. The operation can be made rapidly with complete safety.

This mercury switch has particular utility in relay work and as a heavy duty circuit breaker.

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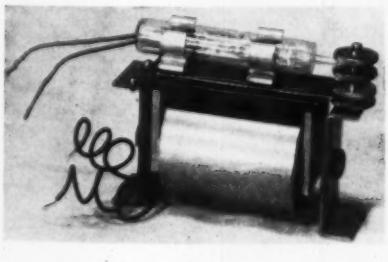
Sensitive Relay

American Instrument Co.

THIS new relay, intended for use with thermostats or photocells, will interrupt 1320 watts, and operates on 4 milliamperes at six volts. It is impervious to dust and dirt, and is safe where an open spark would be hazardous. In spite of its great sensitivity, this new relay is ruggedly built, may be mounted in any position. Contact is made and broken in a vacuum tube. The standard coil has a resistance of 1300 ohms, and relays of this type may be built with coil resistances up to 50,000 ohms. A similar relay with open contacts of silver or platinum-iridium is also available. No covers or special bases are required for these instruments.



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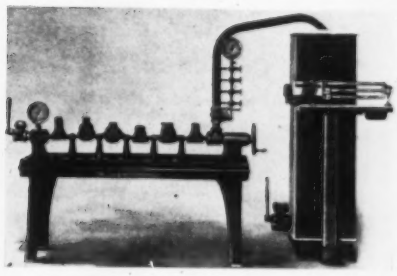
Water Meter Tester

H. W. Clark Co.

IMPROVEMENTS incorporated in an earlier model of this meter tester make it notable for the following features: There is a fractional flow valve, which



permits quick graduated flow on all sizes of meters. Sensibility test valves of needle-point type allow sensitivity test of flows down to 1/32 in. stream. A sloping discharge pipe stops the flow into the tank as soon as the valve is closed, and avoids drip. The sides of the table extend high enough to stop splash, forming an effective splash apron.

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Pendulum Type Torsion Testing Machine 30,000 in.-lb. Capacity

Riehle Bros. Testing Machine Co.

THIS new machine consists of two major units, a loading or twisting unit and a weighing unit. The specimen is gripped in chucks or torsion heads of the three grip sliding wedge type. The head on the loading unit is rotated by means of a spline shaft passing through a heavy worm gear mounted in the loading unit housing. This spline shaft permits the chuck to be slid in two directions so as to accommodate specimens of various length.

Power is derived from an adjustable speed motor driving through suitable worm and spur reduction gears. Two major speeds are obtainable by motor drive, each of which is further adjustable by altering the speed of the motor. A gear shifting lever providing for either of the two major motor speeds, as well as for hand operation, projects from the upper left side of the loading unit housing. The crank for hand operation is mounted at proper height on the front of the loading unit. It is impossible to have more than one speed operative at any one time.

The shafts in the loading unit housing are equipped with Timken roller bearings and ample lubrication is obtained by various gears in the train dipping into the oil, thus insuring high efficiency and long life.

The weighing unit gripping head is mounted on a shaft from which a heavy pendulum is suspended. This shaft is so mounted that it is free to move longitudinally to permit the change of length of the specimen during the test. Mounted in the hub of the pendulum is a horizontal rod which carries three hardened steel points and their supporting bushings. A rack, meshing with the pointer spindle gear, has on its lower end a hardened steel plate, which may rest on any desired one of the three points. The deflection of the pendulum permits this rack to descend, with the plates sliding on the point, and so, by rotating the pointer spindle, enable one to obtain load indications on a circular scale.

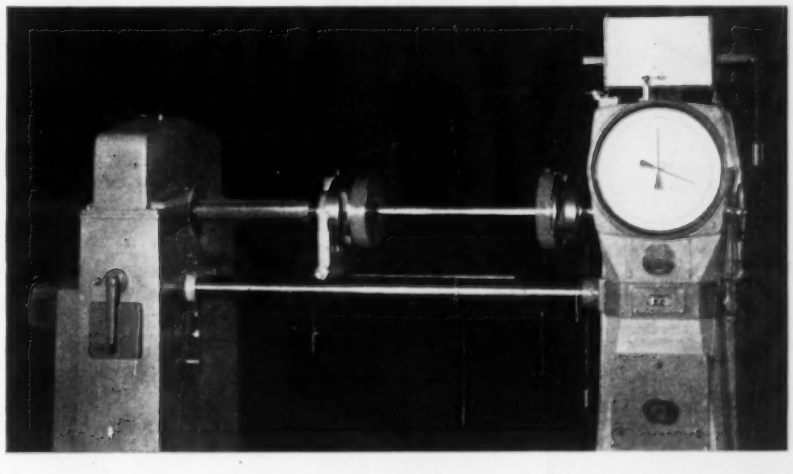
The function of the three points is to afford additional scale ranges. The vertical rack bearing the steel plate, the guide for the rack, and other parts in the assembly can be moved into any one of three positions, and therefore, to rest on any one of three points. Resting on the point number 1 provides full scale readings, or 30,000 in.-lbs., number 2, half scale or 15,000 in.-lbs. and number 3, one-third scale or 10,000 in.-lbs. All three scales are engraved on the dial. Changing from one scale to another is quickly done by means of a rod notched for each of the three positions and held in place by a latch dropped into the proper notch.

If any change in the zero setting is necessary, this may be accomplished by rotating the dial using a knurled button at its right. Each twisting head or chuck is provided with a dial graduated in degrees by which the twist of the specimen can be measured.

The machine can be provided with autographic recorder which plots a curve of twisting moment against degrees twist. The entire curve is visible at all times. Cords run over sheaves attached to the twisting heads in such a manner that the actual relative twist of the two heads only is reported. Load indications are derived from the vertical rack taking its motion directly from the pointer spindle.

The machine is protected from damage resulting from the fall of the pendulum, after a specimen breaks, by means of a hydraulic snubbing device which requires no attention beyond occasional checking of the oil level. This device has no effect on the load indications and only comes into action when the specimen breaks and the pendulum begins to return rapidly.

The motor drive is controlled by a push button station mounted in the front weighing section. The machine is protected against overload by a mercury switch in series with the "Stop" button. When the pendulum reaches its maximum inclination the mercury switch opens the circuit and stops the motor.

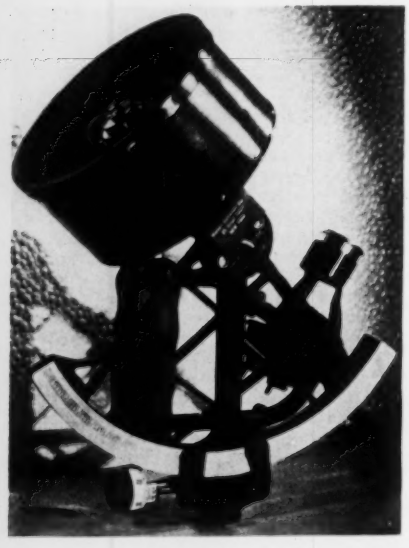


The Macneil All-Weather Sextant

Macneil Instrument Corporation

PRACTICAL NAVIGATORS know that while the compass and the chronometer are practically perfect mechanically, the standard sextant, because it is an optical instrument, cannot be used during storm or other bad weather conditions, at which time navigation is increasingly difficult and increasingly important. The Macneil All-Weather Sextant is the first instrument ever produced which enables a navigator to plot his position from observations of celestial bodies either on clear days or during cloud, fog or other bad weather conditions.

This new sextant is a permanently installed ship's instrument which in no way affects any existing instrument on shipboard and is in no way affected by them. It consists of two devices, the sextant proper, which is a hand held instrument, and the amplifier with its batteries. The amplifier, contained in a case 8x9x20 in., is permanently installed in the ship's wheel house, with rigid conduits leading from it to both flying bridges, where convenient receptacles are placed for plugging-in the two short flexible cables attached to the sextant.



In operation the navigator adjusts the amplifier, a process requiring about 2 minutes, steps out on the bridge, plugs the flexible cable attached to the sextant into the outlet, and takes his observations as leisurely and as often as he desires.

The necessary calculations for fixing a definite position from solar observations taken by this sextant are substantially the same as those required for standard sextants. Index error, parallax and refraction are similar, dip is eliminated, but is replaced by a special temperature correction, while semi-diameter is entirely eliminated.

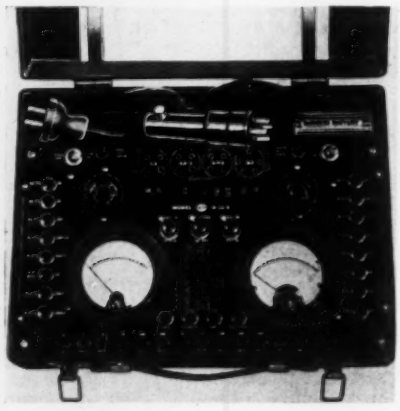
The Macneil All-Weather Sextant is not an optical instrument. It detects certain infra-red rays originating in the sun, after they pass through, or are the cause of re-radiation by, clouds, fog, etc.

The artificial horizon used is an entirely new development, is extremely easy to handle and very accurate.

New Radio Service Instruments

The Franklin Radio Corporation

MODEL D-32-A Combination Set Analyzer and Tube Checker is an instrument comprising a complete set analyzer and a.c. Tube Checker in a single portable case. It will make a complete analysis of all circuit conditions existing in any radio receiver or electrical

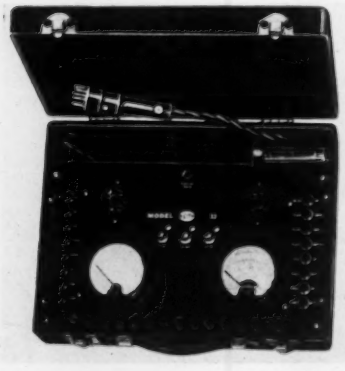


D-32-A Combination Set Analyzer and Tube Checker

apparatus within the limits of 800 volts a.c. or d.c., and current up to 100 milliamperes. A complete tube checker is included, together with a panel chart of the tube ratings, as an integral part of the instrument, thus permitting a complete analysis of any radio receiver and an independent check on its tubes.

The instrument is operated by means of push buttons, and eleven meter ranges are available through the use of pin jacks for external testing. The meters are large three inch diameter Jewell or Weston units. The d.c. meter is rated at 1,000 ohms per volt and the a.c. meter is a double movement instrument to permit lowest current consumption. The instrument is fully protected by circuit arrangement so that no damage may result from incorrect operation, accidental or otherwise.

The Model 32 Analyzer is identical to the Model D-32-A Combination except



Franklin 32 Analyzer

that it does not have a self-contained tube checker.

The Model D-32-A and the Model 32 are furnished in black molded bakelite cases, fitted with gunmetal hardware, removable lid, spring clips in lid for holding instruction sheets, set data, etc. Operating instructions, screen grid [illegible] and test leads with insulated tips complete the equipment.

Both checker models are housed in black molded bakelite cases, with vertichromed front panels. Equipment includes screen grid lead, operating instructions, and adapter for testing 2[illegible] tubes. The Model H-32 is equipped with test leads.

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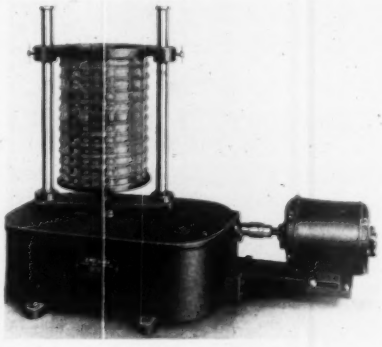
Testing Sieve Shaker

Newark Wire Cloth Company

IN this recently perfected "End Shak" testing sieve shaker, the fundamental idea is to put through any given testing sieve or sieves, in a definite and shorter time interval, all that would eventually pass. The following comparative tests made with No. 45 and No. 120 master (abrasive) samples, using the same set of certified sieves for all tests, show that the basic purpose was carried out:

	X Machine		"End-Shak" Machine	
On Sieve	5 Min.	10 Min.	3 Min.	5 Min.
No. 45	2.1%	2.1%	Tr.	Tr.
50	82.7	80.9	81.0%	77.0%
60	15.2	17.0	19.0	23.0
On Sieve	15 Min.	15 Min.	5 Min.	15 Min.
No. 120	11.4%	7.0%	1.0%	Tr.
140	80.8	82.0	86.8	78.5%
170	7.7	10.5	12.2	21.5

Further, "end-point" (hand sieving) tests made on samples which had been End-Shaken, indicated that Newark's engineering premises were sound.



Among the features of the "End-Shak" machine are: 1, Elimination of most of the variable factors in sieve testing; 2, Bringing the results of laboratory and plant into closer relationship by applying fundamentally sound principles of screening in the following manner: (a) Sample is spread uniformly over the *entire surface* of the sieve. (b) Entire sieve surface is constantly utilized. (c) Jumping and bouncing of the sample particles eliminated; (d) Noise, wear and tear on parts minimized. (e) Smooth, easy operation.

The "End-Shak" weighs 275 pounds including the motor and auto time switch. It is 29 inches high. A standard ¼ H.P. motor is used; 110 and 220 volt; 60 cycle alternating current; 1750 r.p.m. Belt drive or special motor equipment is furnished if desired. The standard auto time switch automatically controls the period of the test. "End-Shak" is designed for 8" diameter testing sieves, and is adjustable to hold any number of sieves from 1 to 13 inclusive.

INSTRUMENTS ABSTRACTS

Abstracts on instruments and devices for measurement, inspection and control.

INSTRUMENTS ABSTRACTS, incorporated in INSTRUMENTS, is the most complete review on the subjects of measurement and control.

Abstractors cover over 700 domestic and foreign publications.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform to our style they are classified.

Oftentimes an abstract can fit under two or even more sections. In that case we decide who will be most interested in the article, and include it under that field of reader interest. It is our aim to so arrange the abstracts that a person interested, for example, in viscosity, will keep in touch with all the important articles in his field if he reads only section 2.10. For instance, an article on "Vacuum Tube Means of Measuring Viscosity" appears under 2.10—under "Measurement and Control of Physical Properties—viscosity," although it would also fit under section (5.4)—"Electronic Devices and their Applications."

An improvement we hope to make in the Abstracts Section in the near future is the cross-indexing of articles which fit under several sections. We suggest glancing through the whole Abstract Section. This takes but a short time, and the time so taken will be found very profitably spent.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted can be obtained at 35 cents per page plus 10 cents for mailing. The remittance should accompany the order.

CLASSIFICATIONS

(By Fields of Reader Interest)

MEASUREMENT TECHNOLOGY (1)

This section includes all matters concerning the art and science of measurement as follows:

Measurement Theory (1.1)

Under this heading will be included: definitions, precision of measurements, systems of units, and dimensional analysis.

Measurement Practice (1.2)

Covers Calibration and Standardization.

Calculation (1.3)

This does not include computation for instrument design, but covers calculations as a mode of measurement.

MEASUREMENT and CONTROL (2)

This section is devoted to those general measurement practices and control applications that are not confined to any one industry or branch of engineering. Thus temperature measurement and control, being of as much importance in chemical as in metallurgical processes, is a general field of interest to all industries and all branches of engineering.

Length, Angle, and Area, Including Surveying (2.01)
Time, Speed, and Acceleration (2.02)
Weight, Density, and Specific Gravity (2.03)
Pressure and Vacuum (2.04)
Flow and Volume (2.05)
Temperature (2.06)
Heat and Combustion (2.07)
Humidity and Moisture (2.08)
Power, Work, and Output (2.09)
Physical Properties, (Viscosity, hardness, elasticity, plasticity, surface tension, etc.) **(2.10)**

TESTING and INSPECTION (3)

Physical Testing and Inspection (Including strength tests, bending, magnetic analysis, X-ray inspection, and other engineering test or inspection methods.) **(3.1)**

Production Testing and Inspection (This includes methods of testing and inspection for setting up production standards, grading, gaging, maintaining quality, etc.) **(3.2)**

Maintenance Testing and Inspection (Included here will be matters concerning standards and methods for controlling performance or service of equipment. Example—The problem of controlling long phone lines to give quality sound transmission would be included here.) **(3.3)**

ELECTRICITY and MAGNETISM (4)

Electrical Properties, Tests, Measurements, and Measuring Instruments (4.1)
Electrical Measuring Devices and Applications (4.2)
Magnetic Measurements (4.3)
Magnetic Properties, Materials, and their Applications (4.4)

ELECTRONICS and RADIO (5)

Radio Measurements (5.1)
Applications of Radio to Measurement and Control (5.2)
Photo-electric Measurements, Devices and Applications (including television) **(5.3)**
Electronic Measurements, Tubes, Devices, and their Applications (Under this heading would be included thermionic tubes, grid-glow tubes, thyratrons, neon discharge tubes, cathode-ray tubes, etc.) **(5.4)**

ACOUSTICS and VIBRATIONS (6)

Sound, Vibration, Phenomena and Measurements (6.1)
Sound and Vibration Devices or Applications (6.2)

LIGHT, OPTICS, and RAYS (7)

Light—General Measurements and Optical Applications (7.1)
Color Analysis, Color Matching (7.2)
Photometry (7.3)
Polarimetry (7.4)

(Continued on page A21)

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pocket Sized

DIRECT READING

FOOT-CANDLE METER

HAVING successfully pioneered the first direct-reading Illumination Meter, Weston now adapts the same principles to a smaller, handier, more compact instrument—Model 614 PHOTRONIC FOOT-CANDLE METER.

Pocket sized, light in weight—this new Weston FOOT-CANDLE METER is ideal for general maintenance of illumination—checking intensities, lamps, reflectors, reflection and absorption of surfaces—maintaining "Measured Lighting"—keeping illumination at the correct established standard.

And Model 614's surprisingly low cost practically dictates its purchase by every organization interested in adequate correct illumination.

Write for Booklet M-1

The new Weston Model 614 FOOT-CANDLE METER reads light intensities directly in foot-candles. No calculations. Three ranges—50 250 500 foot-candles. Completely self-contained—no batteries . . . no lamps . . . no accessories. Nothing to wear out or replace. Easily fits into pocket or brief case. Consists of Weston PHOTRONIC photoelectric cell and indicating instrument calibrated in foot-candles. The cell tips at right angles for measuring horizontal components. Anybody can use it and get reliable, accurate results.

WESTON

ELECTRICAL INSTRUMENT CORP.

591 FRELINGHUYSEN AVENUE . . . NEWARK, N. J.

MEASUREMENT TECHNOLOGY (1)

Measurement Theory (1.1)

The Present Status of Gravity Measurements. (Ueber den heutigen Stand der Schwerenmessungen.) H. Schmehl. *Zeitschrift fur Vermessungswesen*, Vol. 60, No. 24, Dec. 15, 1931, pages 750-756.

The various methods of the determination of the gravity of the earth and, for that matter, its exact shape, are reviewed; the best method is that by observing pendulum oscillations which are exact to 1/1,000,000. The measurements are mostly relative, absolute measurements have not been made since 1914. Modern pendulums are placed in evacuated chambers. The double-pendulum, the astatic pendulum, the method of coincidences, and the static gravity meter are described. Sixteen references are cited. Ha (1.1)

Standards of Measurement. Gordon G. Watrous. *The International Blue Printer*, Vol. 5, Jan. 1932, pages 9-11.

A historical review of the units of measurement used by primitive man and the origin of names now in use is given. The arguments for and against universal acceptance of the metric system are discussed. Ha (1.1)

The Application of Least Squares. W. Edwards Deming. *Philosophical Magazine and Journal of Science*, Series 7, Vol. 11, Jan. 1931, pages 146-158.

The principle of least squares is applied to the general problem of finding the most probable values of observed quantities and of parameters that are related by equations of various sorts. The derivation is based on the statement of the principle that the weighed sum of the squares of the residuals is to be miminized with respect to the most probable values of the observed quantities. Ha (1.1)

A New Electrical Measuring System. (Ein neues elektrisches Mass-system.) E. Rodewald. *Elektrotechnik und Maschinenbau*, Vol. 49, Dec. 6, 1931, pages 895-897.

In the electrostatic as well as in the electromagnetic measuring system, the electrical units are mostly expressed in fractions of the exponent, for instance the electric current is expressed by $c^{3/2}\ g^{1/2}\ s^{-2}$ in the electrostatic, and $c^{1/2}\ g^{1/2}\ s^{-1}$ in the electromagnetic system. It is hardly possible to connect a physical meaning or to form a mental picture with such expressions, especially as the same quantity may appear in two different powers. The author develops a new system based on the structure of the molecules. The quantity of electricity Q is therefore expressed by the number of non-neutralized electrons, as a body is for instance positively charged if there is a lack of electrons and vice versa. Q is therefore dimensionless, a pure number. The absolute number of electrons in the molecule or atom is here irrelevant. Consequently, the electric current is determined by the number of electrons flowing in unit time through the section of the conductor. In this manner all electrical quantities are logically developed and the following table is arrived at:

Designation		Dimension				
Quantity of electricity	Q		..			Number of free electrons
Current	I				s^{-1}	Number of electrons per unit time
Energy	N	c^2	g		s^{-3}	As mechanical energy
Potential	E	c^2	g		s^{-2}	Power per electron
Resistance	R	c^2	g		s^{-1}	Ratio E/I
Inductivity	L	c^2	g			Ratio $E/\frac{dI}{dt}$
Magnetic flux	ϕ	c^2	g		s^{-1}	Integral Edt
Induction	B		g		s^{-1}	Magnetic flux per unit area
Magnetic field intensity	H	c^{-1}			s^{-1}	Current per unit length
Permeability	μ	c	g			Ratio B:H
Capacity	C	c^{-2}	g^{-1}		s^2	Number of electrons per unit of potential
Dielectric displacement	D	c^{-2}				Number of electrons per unit area
Electric field intensity	F	c	g		s^{-2}	Power (per electron) per unit length
Dielectric constant	ϵ	c^{-3}	g^{-1}	s^2		Ratio D/F

There are no fractions in the exponents. The selection of practical units and their ratios to the absolute units of the new system is discussed; they are left almost the same as now used. Ha (1.1)

Note on the Decisions Made by the Sub-Committee on Electrical and Magnetic Magnitudes and Units of the International Electrotechnical Commission at the Meeting in London on Sept. 18, 1931. (Note sur les décisions prises par la Sous-Commission des Grandeurs et Unités électriques et magnétiques de la Commission électrotechnique internationale à la réunion de Londres de Septembre 1931.) A. E. Kennelly. *Revue Générale de l'Electricité*, Jan. 2, 1932, pages 7-11.

Points out there has been much ambiguity in all parts of the world as to the definitions of units relating to the magnetic circuit. Reviews agreements which had been made previously. The national committees of ten countries were represented at the London meeting. Action on a proposal relating to a series of practical magnetic units, based on the volt-second or pramaxwell as adopted at the Stockholm meeting with the ampere-turn as unit of m. m. f., was deferred for consideration by the national committees. At least four C. G. S. magnetic units have not yet received names. These are the units of permeance, permeability, reluctance, and reluctivity. The four units to which definitions and names have now been given (magneto-motive force, magnetizing force, magnetic flux, and flux density) are probably sufficient for present purposes. MS (1.1)

MEASUREMENT & CONTROL (2)

Length, Angle, and Area, including Surveying (2.0)

Modern Design in Mining Theodolites. W. T. Lan... *Coal Trade Review*, Vol. 122, Jan. 16, 1931, pages 71-72; pages 218-219; Feb. 6, pages 252-253; Feb. 20, pages ... Feb. 27, page 368; Mar. 6, pages 397-398; Mar. 20, pa... 475; Mar. 27, pages 520-521; April 3, page 549.

A very comprehensive review of mine surveying ... ments in all their details, treats mostly those of ... make.

The Irregular Reading Error for Medium and Small Theodolites with Verniers, Line-Scale-and Screw-Microscopes. (Der unregelmässige Ablesefehler für mittlere und kleine Theodolite mit Nomen, Strich-Skala-und Schraubenmikroskopen.) K. Luedemann. *Zeitschrift Vermessungswesen*, Vol. ... 1, 1931, pages 589-590.

In a table these errors are computed for basis circ... 12 and 8 cm. diameter of the division scale.

Investigations on the Changes of Length of Surveying Rods made of Wooden Lengths. (Untersuchungen über die Längenänderung von Nivellierlatten aus Sperrholz.) K. Luedemann. *Allgemeine Vermessungsnachrichten*, Vol. 44, Jan. ... 1932, pages 1-7.

Surveying rods made of wood are subjected to chang... length, more or less regular, due to humidity, which ... to be taken into account for very exact measurements. The article reports the measurements made on two rods; it seems that rods made of ends are more satisfactory than rods made of one single piece. A coating preventing absorption of humidity is a fairly good protection against changes of length. Thirteen references.

Investigations and Working in the Field with the Reduction Tachymeter of Bosshardt-Zeiss in Russia. (Forschungen und Feldarbeiten mit dem Reduktions-Tachymeter Bosshardt-Zeiss in Russland.) K. N. Smirnoff. *Zeitschrift für Vermessungswesen*, Vol. 60, No. 24, Dec. 15, 1931, pages 727-739.

For geodetical work, especially surveying of cities, this instrument is widely employed in Russia with good results; the average errors in determination of lengths are about 1/5000, and the costs as compared with surveying by the surveying rod about 30 to 40% lower.

The Sip-Comparators. (Die Sip-Vergleichsmesser.) L. Sa... letsky. *Feinmechanik und Prazision*, Vol. 40, Feb. 1932, pages ... 31.

The instruments, called micro-indicators, are lever-gages and permit exact readings of 1/1000 of a millimeter. The construction is described; they are made by the Société Genevoise d'Instruments de Physique.

East Texas "hurry-up" Methods Cause Many Crooked Holes. M. T. Higgs. *Oil Weekly*, Vol. 63, Nov. 6, 1931, pages ... 38.

Describes several instruments which are used to obtain the amount of deviation from the vertical.

An Improvement on Theodolites. (Eine Verbesserung an Theodoliten.) Adolf Fennel. *Allgemeine Vermessungsnachrichten*, Vol. 44, Jan. 27, 1932, pages 58-59.

The screw which fastens the instrument to the tripod is hollow; through the hole goes the plumb which is suspended on a sphere directly under the axis of the instrument. This assures that the vertical axis is actually over the geometrical point to which the plumb points.

The Recording Theodolite, a Device for Determining the Accuracy of Antiaircraft Fire. Roswell H. Ward. *Army Ordnance*, Vol. 12, Jan. & Feb. 1932, pages 272-275.

The effectiveness of antiaircraft fire is determined by a combination of a professional moving picture camera with a theodolite. The method of operation and the optical system of the theodolite to obtain the required measurements in space are explained. For the mathematical solution of the problem from the films a special computation work sheet is furnished.

A New Precision-Surveying Instrument. (Ein neues Feinnivellier-Instrument.) Ad. Fennel. *Allgemeine Vermessungsnachrichten*, Vol. 44, Feb. 17, 1932, pages 104-107.

The new feature of the instrument is that, by means of a system of prisms and lenses a picture of the level bubble and level division is shown in the field of vision besides the division of the surveying rod. The accuracy is said to be greatly increased thereby. The general construction of the instrument is described.

New Developments of the Leveling Instrument III and of the Precision Leveling Rod of Carl Zeiss. (Neuerungen am Nivellierinstrument III und an der Präzisions-Nivellierlatte der Firme Carl Zeiss, Jena.) Karl Schmelz. *Zeitschrift für Vermessungswesen*, Vol. 61, Jan. 15, 1932, pages 71-73.

A new 1 cm-division and a magnifying glass for reading to increase the accuracy are described.

Investigations on the Influence of Temperature and Air-Humidity in Measurements with the Bosshardt-Zeiss Reduction Tachymeter. (Untersuchungen über den Einfluss von Temperatur und Luftfeuchtigkeit bei Messungen mit dem Bosshardt-Zeisschen Reduktions-Tachymeter.) Dr. Wattner. *Allgemeine Vermessungsnachrichten*, Vol. 44, Jan. 27, 1932, pages 49-57.

A great number of tests which are reproduced show that these two influences on this surveying instrument are practically non-existent.

Approximation Formulas for Marking-out Circles with Given or Equal Arcs. (Ueber Näherungsformeln für die Kreisabsteckung mit Gegebenen oder Gleichen Bogenlängen.) W. Friedrich. *Allgemeine Vermessungsnachrichten*, Vol. 44, March 9, 1932, pages 145-155.

A simple method for the staking out of circles (for roads, railroads, etc.) from the tangent or the chord is developed and illustrated by a numerical example.

The Accuracy of Terrestrial Photogrametry. (Ueber die Genauigkeit der terrestrischen Photogrammetrie.) R. Fe... walder. *Allgemeine Vermessungsnachrichten*, Vol. 44, Jan. 13, 1932, pages 17-22.

An analytical treatment of photogrametric methods. A stereoscopic evaluation accuracy for maps etc. of 0.01 mm. on the topo-plate can be assumed. Suggestions for further work in this direction are offered.

THE REVIEW OF SCIENTIFIC INSTRUMENTS

CONTENTS FOR AUGUST, 1932, ISSUE

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A Field Intensity Meter.

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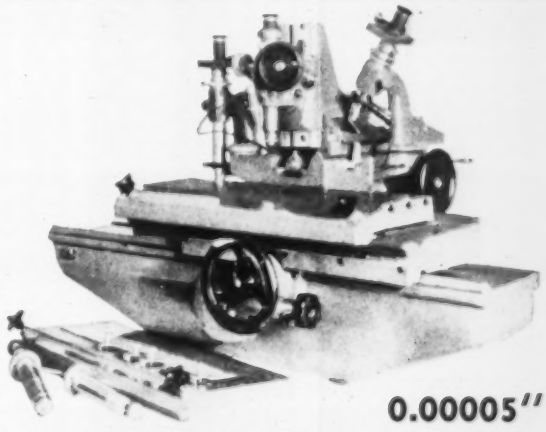

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Flow & Volume (2.05)

Making Water Measurements with Current Meters. SIGMUND J. BITTERLI. *Power*, Vol. 75, Jan. 19, 1932, pages 102-104.

The use of a battery of current meters with a chronograph to give a record of water flow is described. AHE (2.05)

Series Type Feed-Water Regulator. *Power*, Vol. 75, Jan. 19, 1932, page 113.

A regulator is described and illustrated which is designed primarily for boilers operating with rapidly fluctuating loads and to control the water feed in accordance with the rate of steam flow, with compensation for changes in boiler-water level. AHE (2.05)

Electrically Operated Orifice Meter. *Power*, Vol. 74, Dec. 29, 1931, page 949.

An improved form of the self-balancing inductance bridge in which a self-synchronizing motor replaces the secondary coils, actuates the Orifice meter developed by the Builders Iron Foundry, Providence. AHE (2.05)

Feed-Water Regulator With Two Thermostatic Elements. *Power*, Vol. 75, Feb. 2, 1932, pages 182-183.

A feed-water regulator is described and illustrated. AHE (2.05)

Improved Pocket Draft Gage. *Power*, Vol. 75, Feb. 2, 1932, page 183.

An improved Hays portable pocket-type draft gage is illustrated. AHE (2.05)

Flow Measurement and Pressure Recovery with the Siemens-Venturi Insert. (Stromungsmessung und Druckrückgewinnung mit dem Siemens-Venturi-Einsatz.) G. RUPPEL. *Siemens-Zeitschrift*, Vol. 12, Jan. 1932, pages 7-11.

The influence which the retarded flow has on the exact determination of the pressure recuperation is discussed; the advantages of the Venturi-tube with gradually increasing section behind the narrowest part in this respect are explained and an improvement is described with a very short diffusor which has only 6-7% pressure loss of the measuring pressure. The construction is described. Ha (2.05)

Quantity Measurement of Liquids with Wolfman Meters. (Flüssigkeits Mengenzählung mit Woltman-Messern.) G. RUPPEL. *Archiv für Technisches Messen*, 1931, section V1234-1, page T33.

The action of the "hydrometric vane" is explained; this method is very accurate for any amount of liquid down to about 1 m.³/hr., that is even for very slow flow. Besides water, it is also suitable for viscous fluids. Ha (2.05)

High Capacity Gas Meters. Problems and Outlooks. (Hochleistungsgasmesser Probleme und Aussichten.) L. LITINSKI. *Die Messtechnik*, Vol. 7, Nov. 1931, pages 287-296, Dec. 1931, pages 315-319.

From a discussion of the properties of dry and wet gas meters it is concluded that for large capacities the dry meter is the more suitable type. The pressure loss in meters up to 37.5 m³/hr. is discussed and figures given; the different types, their parts, valves, diaphragms, requirements for reliable operation, etc., are treated in detail. Ha (2.05)

Flow Measurement and Control. M. F. BEHAR. *Instruments*, Vol. 5, Jan. 1932, pages 15-18.

Gives a classification of instruments related to flow on basis of operating principle, the classes being divided into two groups—positive and inferential. Classifications are summarized in tables. HO (2.05)

Flow Measurement and Control. M. F. BEHAR. *Instruments*, Vol. 5, Feb. 1932, pages 47-51.

Head Meters is the title of this chapter of a forthcoming "Manual of Instrumentation." Lists table of symbols, then treats types of primary elements, their location, and the connecting piping used with them. Ends with a consideration of the relation between rate of flow and differential pressure. Ho (2.05)

California Companies Metering Gasoline Even to Tank Truck Deliveries. J. N. WESTSMITH. *National Petroleum News*, Vol. 23, Nov. 25, 1931, pages 55-56, 58, 60, 62.

Only a question of time until mechanical measuring devices will entirely displace stick gauging in distribution from the refinery to the passing of goods to the consumer. (2.05)

Water-Level Indicator. *Electrical Review*, Feb. 5, 1932, page 199.

Brief description of a pressure and altitude gage with which is combined an overhead-tank water-level indicator, invented by Sydney A. M. Rose and manufactured by the Budenberg Gauge Co., Ltd. MS (2.05)

Gas Flow Regulators. LINDE AIR PRODUCTS COMPANY. *Instruments*, Vol. 5, Feb. 1932, page 58.

These new regulators are for delivering to the welding blowpipe tip, or cutting blowpipe, at uniform pressure, the required volumes of oxygen and acetylene essential for maintaining a neutral flame. HO (2.05)

Measuring Technique in the Institute for Flow-machines of the Technical University Karlsruhe. (Messtechnisches aus dem Institut für Stromungsmaschinen der Technischen Hochschule Karlsruhe.) F. KRISAM & F. R. LORENZ. *Messtechnik*, Vol. 6, Oct. 1930, pages 271-273.

The following measuring equipments are described. a manometer plant with compressed air for reading directly pressures and exhaust of turbines; a motor-controlled bralle for determining the capacities of turbines; an arrangement to measure quantities of water falling over weirs exactly, also remotely. Ha (2.05)

The Measurement of the Gaseous Products in the Foundry. (La Mesure des Débits Gazeux en Fonderie.) H. LAPLANCHE. *Revue de Fonderie Moderne*, Vol. 25, Dec. 25, 1931, pages 453-463.

The usefulness of determining quality and quantity of gases escaping from the foundry with regard to whether too much or too little air is used in certain combustion processes is discussed and the different methods and principles of measuring gas flow and metering instruments are described. Ha (2.05)

Temperature (2.06)

The Potentiometric Measuring Methods for Precise Determination of Thermo-Couple Voltages. (Die potentiometrischen Messverfahren zur genaueren Bestimmung von Thermospannungen.) CH. KESSLER & J. KROENERT. *Siemens-Zeitschrift*, Vol. 11, Aug./Sept. 1931, pages 384-389.

Two methods are mainly used for determining [illegible] thermocouples: the compensation method, in which the voltage to be measured is counteracted by another [illegible] no current, therefore, flows in the test circuit. In the [illegible] pression method a counter-electromotive force is [illegible] but only in a part of the measuring range, the other [illegible] suppressed; in this case a current exists. The latter [illegible] is especially used for continuous operating measurements for recording purposes within certain temperature [illegible] Both methods are more fully explained.

Preparation of Bismuth-Antimony Vacuum Thermoelements by Vaporization. (Die Herstellung von Wismut-Antimon-Vakuumthermoelementen durch Verdampfung.) W. BURGER & P. H. VAN CITTERT. *Zeitschrift für Physik*, Vol. 66, No. 3/4 1930, pages 210-217.

The metal is vaporized by laying a thin Bi or Sb [illegible] within an spiral and heating electrically. Just below the whole being enclosed in a vacuum app., thin strips of mica are laid out, partly masked and Bi is deposited on the exposed portions of several strips simultaneously. This position is in turn masked and Sb deposited on the remainder. Good couples were obtained with a Bi layer of 0.5μ and Sb half as thick. The method is illustrated. These couples have a high sensitivity and low thermal inertia and are particularly useful for measurements of radiation. Ha (2.06)

Industrial Heat Measurements in the Metal Foundry. (Wärmetechnische Messungen in der Metallgiesserei.) W. WINKHAUS. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 13, 1931, pages 227-229.

The article deals, in a general way, with the influence of the quality of the product of temperature in drying, melting and pouring, and points out the importance of measuring instruments on the production of sound castings. Supervision of temperatures by recording instruments and of consumption of fuel oil with counters, immersion pyrometers with large scales for melting and automatic recording instruments are briefly discussed and explained. Ha (2.06)

Measurement of Temperature Differences with Resistance Thermometers at two Variable Temperatures. (Temperaturdifferenz-Messung mit Widerstands thermometern bei zwei veränderlichen Temperaturen.) W. GEYGER. *Archiv für Technisches Messen*, 1931, section V2166-2, page T66.

The suitable connection in a Wheatstone bridge or [illegible] tient meter connections to give the greatest accuracy independent of exterior temperature are discussed for obtaining readings in exact proportion to the difference of two independently varying temperatures. Ha (2.06)

Measurement of High Temperatures. B. BARHAM & E. [illegible] *Electrical Review, London*, Vol. 106, April 18, 1930, page 7[illegible] April 25, page 806.

Note by B. Barham and letter to the editor by E. Oram on the base metal thermocouples now available for the measurement of high temperatures. These include couples of nickel and iron, nickel and copper, iron and Constantan (nickel-copper alloy) and nickel-chromium with nickel treated with aluminum. The latter form of couple may be relied upon for satisfactory service at temperatures up to 1000° C. (1832° F.) and life at this temperature is quite considerable. It therefore very successfully bridges the gap between 750° C. (1382° F.), for which temperature iron-Constantan couples may be used and 1000° C. (1832° F.), above which platinum-platinum-rhodium couples are necessary. Sheathing for thermocouples subject to temperatures of 800°-1050° C. (1472°-1922° F.) is now almost invariably made from a nickel-chromium heat-resisting alloy. Ha (2.06)

The Measurement of the Peltier Effect in Tungsten-Molybdenum. (Die Messung des Peltier-Effektes an Wolfram-Molybdän.) EGON BLUMENTHAL. *Annalen der Physik*, Vol. 7, 1930, pages 470-488.

The heat evolved when a current is passed through a welded tunsten-molybdenum thermocouple junction has been determined between room temperature and 2600° K. It may be expressed by the equation $Q = 33.6 \times 10^{-9}T^2 + 28.9 \times 10^{-6}$ T grm.-cal. The relation between Q and the thermoelectric power of the couple is in close agreement with theory. Ha (2.06)

A Sensitive Flexible Thermostat. J. R. ROEBUCK. *Review of Scientific Instruments*, Vol. 3, Feb. 1932, pages 93-100.

The principle is to utilize the temperature change of resistance of one or two coils of wire to unbalance a Wheatstone bridge whose galvanometer then controls the heating current by means of a photoelectric cell and vacuum tube current amplifier. The whole apparatus is described in detail. Ha (2.06)

Temperature Measurements of Liquid Copper and its Alloys. (Ueber Temperaturmessungen an flüssigem Kupfer und seinen Legierungen.) H. MIETHING & CH. WINKLER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 27, 1931, pages 181-184.

Immersian pyrometers are subject to great wear and therefore, are not suitable for a continuous supervision of the pouring temperature. For this reason, an attempt was made to determine how exactly radiation pyrometers indicate the temperature as the liquid metal cannot be considered a black body. The measurements described were made with a Holborn-Kurlbaum pyrometer on pure Cu, phosphor-bronze, bronze B, bronze 4, bearing bronzes and red brass and brass. The exact analyses for these alloys are given. Where possible, several color filters were used. The corrections for the measurement at the free-radiating surfaces are determined and tabulated for all metals. The agreement with the immersion measurements are fairly good except for those metals which emit vapors when great differences due to absorption can take place. Ha (2.06)

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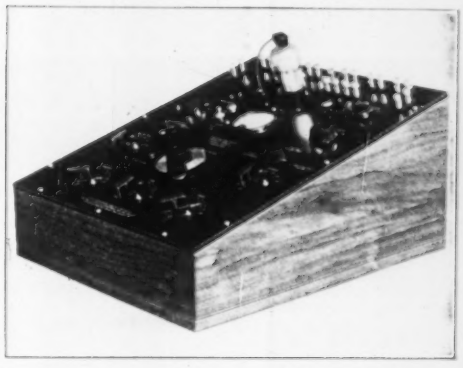

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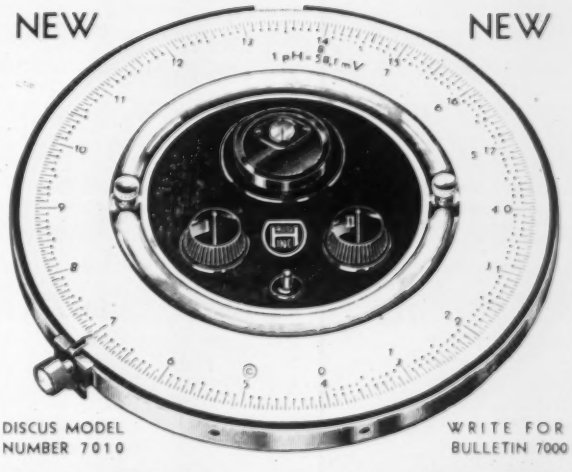

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Heat & Combustion (2.07)

Relative Heat Transfer Through Refractories. A. S. Watts & R. M. King. *Ohio State University Studies, Bulletin No.* 64, 1931, 32 pages.

The methods by which heat is transferred and the laws governing these methods are reviewed; the mathematical expressions for the determination of heat conductivities of refractory materials are discussed. The samples consisted of 9 in. straights, 2.5 in. thick, and 9 in. splits, 1.25 in. thick of a great number of chemically different materials, and were tested at hot face temperature of 800° and 1000° C. The method permitted an accuracy of 10%. It can be stated that the surface greatly influences the heat-transfer; many factors affecting the heat transfer have seldom been taken into consideration, which accounts for unreliable values of commercially fabricated pieces. Heat transfer can be only roughly correlated with chemical composition and physical properties of the pure crystal, but other factors such as porosity, surface effects and the heterogeneity of the mass must be considered. The factors to be considered are: 1, the technique of measurement; 2, the physical properties of the pure crystal; 3, the surface properties of the test piece; 4, the porosity of the test piece. In an appendix the test method used is critically analyzed, and a list of 81 bibliographical references is added. Ha (2.07)

Automatic Combustion Indicator. Hays Corporation. *Instruments*, Vol. 5, Jan. 1932, page 19.

This automatic combustion indicator is designed to provide continuous indications of CO_2 content of flue gases. The aspirator draws off a measured sample of gas, then directs this measured sample into an absorption chamber filled with chemically wet steel wool. CO_2 is immediately absorbed out, causing a pressure reduction in a metallic bellows which provides ample torque for operating the indicator. Ho (2.07)

Portable Ranarex-Apparatus for the Investigation of Flowing Gases. (Tragbarer Ranarex-Apparat zur Untersuchung strömender Gase.) A. Ringer. *A E G -Mitteilungen*, Jan. 1932, pages 29-33.

A new gas density meter is described which indicates small difference in density independent of temperature, barometric pressure, sea level and number of revolutions. The principle of the instrument rests on the dynamics of aeriform bodies; imparting to the gas to be measured a high velocity and letting it act in an uninterrupted circuit on a counter. The construction is described in detail, it is particularly intended for use in large power stations or heating plants for supervision and checking the combustion. The apparatus weighs only 4 kg. Ha (2.07)

The Measurement of True Specific Heats of Solid and Liquid Metals at High Temperatures. (Ueber die Messung wahrer spezifischer Wärmen fester und flüssiger Metalle bei hohen Temperaturen.) Horst Seekamp. *Zeitschrift analytische und allgemeine Chemie*, Vol. 195, Feb. 7, 1931, pages 345-365.

The difficulties of measuring specific heats at elevated temperatures are explained and a method is described to make an accurate determination of this property possible. This is done by a tungsten spiral suspended in the hollow of the cylindrical specimen which is placed in the furnace and heated to the desired temperature. The apparatus used, the tests made and results obtained are described in detail. Ha (2.07)

Boiler Water Level Recorders. Bailey Meter Co. *Instruments*, Vol. 5, Feb. 1932, page 56.

This water level recorder operates on the difference in level obtained by making two connections to the water column or boiler drum. The variable head or water space connection is applied over a mercury sealed bell and the constant head connection is applied to the inside of this bell. As the boiler water level rises or falls, the mercury sealed bell falls or rises and this motion is transmitted to the recording pen by a forked lever and a spindle. Ho (2.07)

Measurement of Dust in Flue Gases. (Messung von Flugstaub in Rauchgasen.) E. Zimmermann. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, April 18, 1931, pages 481-486.

The existing optical and other devices for the indicating or recording of the amount of smoke do not give an indication of the amount of dust in combustion gases but only a general idea as to the completeness of combustion. The Berlin Electricity Works developed several methods to measure the content of dust which in principle are based on partial currents derived from the principal current of gas flow; the dust contained therein is caught in filters. The increase in weight of the filter gives the weight of dust and as the amount of gas is known the content of dust for a definite amount of gas can be calculated. The various constructions of filters and different filter materials are described and test results with them are given; curves for calculation are derived. Ha (2.07)

Combustion Safety Control. Minneapolis-Honeywell Regulator Co. *Instruments*, Vol. 5, Jan. 1932, page 20.

The Protectoglow utilizes the grid glow tube. The grid of this tube is connected directly to an electrode of heat resisting alloy extending into the flame. A relay, which handles the electric valves, etc., of the burner, is in the plate circuit of the tube. The electrical arrangement is such that when the grid of the tube is grounded through the electrode and the flame, the relay closes. When this circuit from grid to ground is broken by flame failure, the relay opens. HO (2.07)

Combustion Control Regulator. Morey & Jones, Ltd. *Instruments*, Vol. 5, Jan. 1932, page 20.

A spring is set to balance the desired boiler pressure, exerted on a diaphragm. As the boiler pressure increases above this point, water or compressed air from a constant pressure source is admitted to exert pressure on a regulator-operating diaphragm. Ho (2.07)

Composite Gas Sampler for Boiler Gases. H. F. Mullikin. *Power*, Vol. 75, Dec. 8, 1931, page 837.

A sampler is described and illustrated for simultaneously taking flue-gas samples from many points in the flue to give a representative, composite sample for analysis. AHE (2.07)

TESTING & INSPECTION (3)

Physical Testing & Inspection (3.1)

Testing Rack for Measuring Instruments in the Building Trade. (Prüfstand für Messgeräte im Bauwesen.) [illegible] Hard. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Dec. [illegible] 1931, pages 1559-1562.

The purpose of the rack is to produce stresses, [illegible] as well as dynamic, artificially in a manner comparable [illegible] to those to which the instrument is exposed when attached [illegible] to buildings, structures, etc. The construction and electrical and mechanical means for production of stresses are described. Electromagnetic and optical observation make possible [illegible] detection and record static deflections of from $\frac{1}{2}$ to 2000μ and oscillations up to 300 Hz. The calibration of instruments is described and suggestions offered for possible further use of the arrangement in other fields. Ha (3.1)

The Measurement of Welded Seams. (Das Messen von Schweissnähten.) E. Kalisch. *Schmelzschweissung*, Vol. [illegible], 1931, pages 181-183.

As all values of strength of welded seams are given in lbs./in.^{2} or kg./mm.^{2}, the exact measurement of the dimension of the weld is of importance. A few special gages and methods of using them are described and illustrated. Their object is to obtain as correct a value as possible. Ha (3.1)

The Graphical Evaluation of the Bending Test. (Die zeichnerische Auswertung des Biegeversuchs.) R. Mitsch. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 20, 1931, pages 246-247.

A generally applicable method is developed to determine graphically the bending strength of cast iron. Numerical example illustrates the method. Ha (3.1)

Progress in the X-Raying of Iron. (Fortschritt in der Röntgendurchstrahlung von Eisen.) M. Widemann. *Die Giesserei-Zeitung*, Vol. 18, July 17, 1931, pages 576-580.

The factors affecting the further progress in testing with X-rays large metal pieces, especially of iron, are discussed in detail. X-ray tubes should be developed to stand a continuous operation with considerably more than 200 KV as are now available. The equipment of the iron-metallurgical Institute of the Technical University, Berlin, is described and the methods usually applied are described. Exposing times for cast iron in milli-ampere-seconds as a function of the thickness of the iron are determined and also as a function of the voltage. A few formulas are developed for calculating the time required for a given thickness of material and blackening effect of the film. Ha (3.1)

The Right Amount of Metal in the Right Place. R. W. Slantz. *Product Engineering*, Vol. 2, Sept. 1931, pages 385-389.

Structures of such shape that the stresses cannot be analyzed mathematically require laboratory determinations. Even then, the best design with regard to stresses will result in a defective product if its proportions cause difficulty in producing an article with sound metal throughout, free from residual stresses. Impact resistance increases with yielding and uniformity of stress distribution; but excess metal causes increased stiffness and wide stress variations. Hence, the necessity for accurate stress determination for structures subject to dynamic loads results. Methods for making tests and arranging the instruments at the proper places are described and a few examples of properly laid out designs illustrated. Ha (3.1)

Magnetic Analysis of Steel. *Electrical Review*, Vol. 109, Dec. 18, 1931, page 910.

Describes system developed by the Magnetic Analysis Corporation, New York. Two magnetizing coils having primary windings of the same number of turns are connected in series. A standard bar of steel, of similar section to that to be tested, is placed in the center of one coil and is inclosed in a tubular chamber, through which running water is passed to prevent overheating by eddy currents. Bars to be tested are passed slowly through the center of the other coil by means of a motor-driven feed mechanism. There is a secondary search coil inside of each main coil, which can be changed to suit the size and shape of the bar to be tested. These coils are connected in series but opposed to the primary coils so that induced currents tend to neutralize each other. The secondary coils are connected to the galvanometer of a visible-type oscillograph. Gives typical curves obtained in testing various steels. Process is at present limited to mild-steel bars up to 2 in. diam. and alloy steels up to 3 in. MS (3.1)

Measurement on the Degree of Orientation in Hard-Drawn Copper Wires. W. A. Wood. *Philosophical Magazine and Journal of Science*, Series 7, Vol. 11, Feb. 1931, supplement, pages 610-617.

An investigation is made of the degree of orientation across the section of hard-drawn copper wire and of the way these measurements differ as the wire is further drawn, and a method is described whereby the degree of orientation may be estimated with the aid of a photometer. A core effect is found to exist; a non-oriented layer encloses an oriented core and the line of demarcation is quite sharp. The results are discussed in connection with the mechanical action of dies. Ha (3.1)

The Growing Importance of Tests—What they Mean to the Welder and to the Welding Industry. H. L. Whittemore, John J. Crowe, A. B. Kinzel, & W. B. Miller. *Paper presented to the 32nd Annual Convention of the International Acetylene Association*, Chicago, Nov. 1931.

The need for testing welds is discussed—tests are the only way to keep welds good. They are grouped in three classes. 1. design tests to determine the value of a new base metal, a new method of welding, or a new design of joint. The specimens should be fabricated by a qualified welder. These tests are usually carried to destruction, the structure being unusable after test. 2. Qualification test for welders. As the properties for manual welds depend greatly upon the care and skill of the welder, materials and equipment are used as in actual production and tests made at frequent intervals to determine the welder's ability to make safe welds. 3. Product tests to insure a satisfactory product; these are destructive and non-destructive tests. The various methods for ascertaining physical properties and soundness of the weld by this group are described. Ha (3.1)

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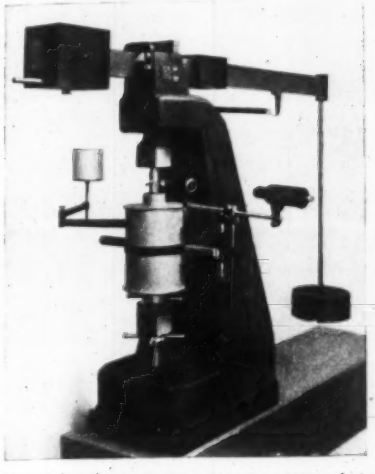

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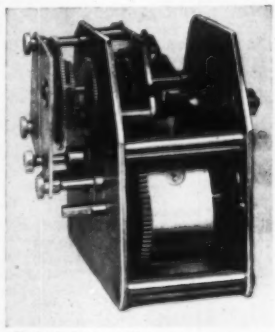

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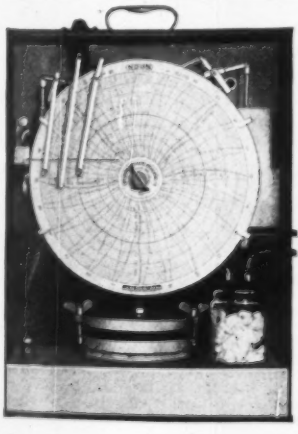

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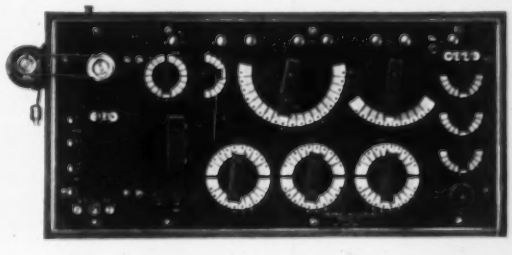

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Limitation of Measurements in Testing of Cables and Pupin-Coils in Manufacture. (Messeinschrankungen bei der Prüfung von Kabeln und Pupinspulen im Lieferwerk.) H. Reuschel. *Siemens-Zeitschrift*, Vol. 11, July 1931, pages 370-373; Aug. & Sept., pages 412-414.

For reasons of economy the electrical measurements of cables and Pupin-coils will often have to be restricted, this can be done quantitatively by selecting only a few circuits of the total for determining the guaranteed values, or qualitatively, by simply determining that the guaranteed figures are not exceeded, but not the exact values themselves. How and when these two methods should be applied is explained fully in the paper. Ha (3.2)

Characteristic Properties of Foundry Coke. (Kennzeichnende Eigenschaften von Giessereikoks.) F. Brinckmann & A. Nehmitz. *Giesserei mit Giesserei-Zeitung*, Vol. 18, June 26, 1931, pages 515-516.

Besides humidity, ashes and content of S, coke for cupola furnaces must also have a certain strength. A method by which an objective impression may be gained is described. It consists of a "drop-drum test." A drum 1 m. in diameter and 1 m. long which rotates for 4 mins. with 25 r.p.m. is filled with 50 kg. of coke. After this, the coke is sorted by means of sieves; parts of more than 40 mm. are designated as strength; from 20 to 40 mm., as brittleness; and the parts under 10 mm. as abrasion. The results of such a test are said to show great regularity. Ha (3.2)

Sensitive Dynamic Balancing Machine. Globe Tool & Engineering Company. *Instruments*, Vol. 5, Jan. 1932, page 20.

This machine is designed to provide a sensitive, accurate, balancing machine for high speed rotating elements, particularly the armatures of small series motors. The unbalance force is found electrically, using only one direction of rotation. Ho (3.2)

On a Theoretical and Experimental Investigation of the Stresses in a Radially Spoked Wire Wheel Under Loads Applied to the Rim. A. J. Sutton Pippard & W. E. Francis. *Philosophical Magazine and Journal of Science*, Series 7, Vol. 11, Feb. 1931, pages 233-285.

The theoretical analysis, arithmetical solutions of certain cases, experimental investigation of the stresses exerted in wire wheels are given and practical formulas for the stresses and maximum tension in a spoke developed which are good for any number of spokes and increase in accuracy as the number of spokes increases. Ha (3.2)

Measuring Instruments for Grinding Machines. (Messgeräte für Schleifmaschinen.) G. Kaiser. *Feinmechanik und Präzision*, Vol. 40, Jan. 1, 1932, pages 8-11.

Automatic outer and inner gages are described and their application explained. Ha (3.2)

Guaranteed by X-Ray Inspection. W. H. Shipman. *American Machinist*, Vol. 75, Nov. 5, 1931, pages 708-709.

Guess-work in the fabrication of welded boiler drums, oil stills, and other pressure vessels is eliminated by using the X-ray for formulating production technique and in final inspection. (3.2)

Vibroscope for Textile Finishing Plants. Electrocon Corporation. *Instruments*, Vol. 5, Feb. 1932, page 54.

On a tentering frame it is essential to keep the weft threads perfectly parallel with the warp threads, but it is very difficult and straining to the operator's eyes to follow the weave of the material as it runs through the machine. A reflector which contains 3 neon tubes and is faced with a sheet of opaque glass to diffuse the light, is placed behind the cloth, and the speed of flashing of the neon tubes is synchronized with the speed of the cloth. This makes the cloth appear perfectly stationary, and it is a very simple matter for the operator to maintain the correct relation between the weft and warp threads. HO (3.2)

Torsiometer. Coats Machine Tool Co., Inc. *Instruments*, Vol. 5, Feb. 1932, page 54.

This machine is designed for torsion testing of torsion and spiral springs. It consists of a bed with raised headstock support for the scale and V-guides for the tailstock, with an automatic stop locating the testing position. Ho (3.2)

Connecting Rod Testing Auto-Gage. Toledo Precision Devices, Inc. *Instruments*, Vol. 5, Feb. 1932, page 60.

The device consists of 2 separate machines. One of them performs the initial weighing of the connecting rod. The second machine consists of an automatic cut-off device connected with a shaving machine placed next to it. The connecting rod is placed in the shaving machine and pared to the proper diameter, at which point the automatic cut-off stops the operation. HO (3.2)

Indicator Test Gages for Ball-Race Seats. Philip F. Shafran. *Machinery*, Vol. 38, Jan. 1932, pages 344-346.

Illustrates and describes a depth gage for measuring from the face of the automobile crankcase to the seat of the ball bearing race. RHP (3.2)

Turbine Oils. A. B. Owles. *Electrical Review*, Feb. 5, 1932, pages 189-190.

Outlines tests for determining their suitability. Tests usually applied are specific gravity, flash-point, viscosity, demulsibility, resistance to oxidation, and organic acidity. MS (3.2)

Comparison of Some Fabric Testing Methods. J. A. Matthew. *Journal of the Textile Institute Transactions*, Vol. 22, Nov. 1931, pages T497-532.

The characteristics of fabrics which are mainly governed by durability or ability to stand wear and tear are at present tested by various methods which are not based on any scientific method. The present work was undertaken to compare the results of such methods of fabric testing with actual service behavior. The experimental details of these tests are described and the results with respect to tensile strength, extension at break, bursting strength, impact strength, tearing strength, resistance to wear by rubbing and to laundry wear are summarized; details must be seen in the paper. Ha (3.2)

Recent Applications of the Iron-Ring Quotient Meter. (Neue Anwendungen des Ringeisen-Quotientenmessers.) W. Geyger. *Archiv Elektrotechnik*, Vol. 25, Sept. 10, 1931, pages 655-658.

This instrument is used as indicating and recording apparatus for the electrical transmission of measured quantities and for thermometric measurements with resistance thermometers. Some new uses and their methods are described for determining short-circuits of windings, for demonstrating electrical resonance and to measure the frequency of a resonance phenomenon. Eleven references are cited. Ha (4.1)

The Sensitivity of the Schering-Bridge. (Die Empfindlichkeit der Scheringbrücke.) J. L. Miller. *Elektrotechnik & Maschinenbau*, Vol. 49, Sept. 6, 1931, pages 677-678.

Approximation formulas are developed to determine the sensitivity of the bridge and instructions are given for the proper arrangement and use of this instrument. Ha (4.1)

The Sensitiveness of an Alternating Current Bridge. (Die Empfindlichkeit einer Wechselstrombrücke.) H. Sc... *Elektrotechnische Zeitschrift*, Vol. 52, Sept. 3, 1931, pages 1133-1134.

A method is developed to calculate beforehand whether an object can be measured with sufficient accuracy in a bridge system with given instrument. Ha (4.1)

A New Method of Measuring the Capacity of Small Condensers. H. M. Barlow. *Philosophical Magazine and Journal of Science*, Series 7, Vol. 11, Jan. 1931, pages 184-193.

When measuring the capacity of very small condensers, under about 100 micro-microfarads, the inherent capacity of the commutator which is best applied for such measurements, becomes so large that it influences the results seriously. The commutator is replaced by ordinary rectifying valves which charge the condenser periodically in opposite directions. Theory, method of measurement, and limitations of the method are discussed. Ha (4.1)

Voltage Measurement on the Principle of the Electrical Wind. (Spannungsmessung nach dem Prinzip des elektrischen Windes.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section J836-1, page T61.

The electrical wind occurs on a point which is under a high voltage, and is caused by the repulsion of ions which are formed by the high field density. The effect is stronger if the point is heated. Apparatus built on this principle are described and the methods of calibration explained. Ha (4.1)

Measuring Bridges; the Calculation of Alternating Current Bridges. (Messbrücken; Berechnung von Wechselstrombrücken.) Jos. Kroenert. *Archiv für Technisches Messen*, 1931, section J920-1, pages T92-93.

The theoretical principles of alternating current Wheatstone bridges and their many modifications are explained. The formulas of their performance and the vector diagram of a bridge are derived. Ha (4.1)

Insulation of Electrical Measuring Instruments. (Isolierung von elektrischen Messgeräten.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section J027-1, page T88.

The requirements and nature of insulation are discussed and the regulations of various countries compared. Tests for determining the insulation are described and the required value for different types of instruments tabulated. Ha (4.1)

Measurement of Alternating Voltages with Condensers. (Messung von Wechselspannungen mit Kondensatoren.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section J333-2, pages T84-85.

The condensers are mostly built into large bushings and their natural capacity increased by additional capacity. The measurements are made either with the instrument in series with the condensers or the condenser is used as voltage divider. Several types of arrangements are described. Ha (4.1)

Electrical Measuring Instruments, Suggestions for Simplified Rules. (Elektrische Messgeräte, Vorschläge für vereinfachte Regeln.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section J00-1, page T72.

The rules for rating and testing electrical measuring instruments are fairly intricate in England, Germany, France and other countries. It is therefore suggested to simplify these rules: for the classing of instruments it is proposed to have three grades: finest precision instruments, checking instruments, and switch board instruments, and to denote their accuracy by a figure referring to the full deflection. Permissible errors, exchangeability, influence of temperature and frequency and testing conditions are considered. Ha (4.1)

Discussion of Electrical Surge Testing from the Point of View of the Surges Produced by Lightning. (Zur Frage der elektrischen Stossprüfung von Standpunkt der Gewitterüberspannungen.) W. Schilling. *Elektrotechnische Zeitschrift*, Vol. 52, Dec. 31, 1931, pages 1591-1596.

The measurements made in Europe and America to determine surge voltages due to lightning are reviewed and the relation between magnitude of voltage and wave form of voltage of induced thunderstorm voltages theoretically investigated. Based on these considerations the testing by surge voltages used so far is discussed, and a simplification is suggested to use rectangular surge wave form of a duration of 3 to 10 millionths of a second. The front of the wave should be as steep as possible. A reference list of 23 articles is added. Ha (4.1)

Cascade Current Transformers. (Kaskaden-Stromwandler.) Willi Reiche. *Archiv für Technisches Messen*, 1931, section Z281-1, pages T94-95.

Cascade connection is applied where very high tension makes it not feasible to transform the whole potential difference in one step. The mechanical and electrical construction is described; error curves and modes of application are discussed. Ha (4.1)

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Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
Amplifying
R. Y. Ferner Co.
Comparator
R. Y. Ferner Co.
Cylinder
R. Y. Ferner Co.
Deformation
Baldwin-Southwark Corp.
Depth
Dial
R. Y. Ferner Co.

Moving Iron Quotient Meters with Annular Moving Iron. (Dreheisen-Quotientenmesser mit ringförmigem Dreheisen.) W. GEYGER. *Archiv fur Technisches Messen*, 1931, section J733-2, page T74.

A quotient meter indicates directly the quotient of two direct or alternating currents and is used to measure resistances or changes of resistance. The construction of the instrument, principle and sensitivity are described, and the influence of changes of voltage and frequency discussed. Ha (4.1)

The Development of Measuring Devices for High Tension. (Die Entwicklung der Messeinrichtungen für Hochspannung.) GEO. KEINATH. *Elektrotechnische Zeitschrift*, Vol. 52, Dec. 24, 1931, pages 1561-1565, Dec. 31, pages 1596-1600, 1606-1609.

The paper reviews the progress made during the last years in the design of potential and current instrument transformers for high tension systems. The construction has been greatly influenced by considerations of safety, and the accuracy has been increased so greatly that the measurements made with transformers are as accurate as those made directly. The general requirements for such transformers are discussed on the basis of the German standards and treated from the point of view of accuracy, secondary output, capacity, rating, insulation, thermal resistance, magnetic materials, overload. The different types, such as loop transformer, pot transformer, bushing transformer, cascade transformer are described and their advantages or disadvantages discussed. Ha (4.1)

VDE-Rules for Current Transformers. (VDE-Regeln für Stromwandler.) GEO. KEINATH. *Archiv für Technisches Messen*, 1931, section Z20-1, page T80.

The latest edition on definitions, overload capacity, thermal capacity, errors, classes and types of construction is discussed. Ha (4.1)

Measurement of Ground Currents in Alternating Current Systems. (Messung von Erdschlussstromen in Wechselstromnetzen.) GEO. KEINATH. *Archiv für Technisches Messen*, 1931, section V3226-1, page T67.

The necessity of supervision of ground current between the star point of a power transformer and ground is explained and the method of recording and automatic signaling described. Ha (4.1)

Influence of Exterior Magnetic Fields on Electrical Measuring Instruments. (Magnetische Fremdfelder Einfluss auf elektrische Messgeräte.) GEO. KEINATH. *Archiv für Technisches Messen*, 1931, section J024-1, page T73.

The kind of disturbing fields, direct or alternating, and their calculation is explained, the permissible influence on instruments according to German rules defined, and the magnitude of error for different types of instruments discussed. Protective measures are described. Ha (4.1)

The Measurement of the Self-Inductivity of Iron Choke Coils. (Die Messung der Selbstinduktivität von Eisendrosseln.) H. TEUCHERT. *Elektrotechnische Zeitschrift*, Vol. 53, Feb. 4, 1932, pages 103-104.

A measurement by means of voltage and current with direct and alternating current is described which gives sufficiently accurate values for practical purposes. An example illustrates the method. Ha (4.1)

Wattmeter and Multi-harmonic Alternating Current. (Leistungsmesser und mehrwelliger Wechselstrom.) G. RASCH. *Elektrotechnische Zeitschrift*, Vol. 53, March 24, 1932, pages 284-287.

An analytical treatment of the indication of three-phase wattmeters in different connections show that not all connections give the actual output if the current is not absolutely sinusoidal, that is if harmonics are present. Especially reactive component meters do not show correct values if harmonics of certain order are present. Ha (4.1)

Mounting Base. ROLLER-SMITH COMPANY. *Instruments*, Vol. 5, Jan. 1932, page 19.

This mounting base is for mounting any flush model, Type TA, TD, or TW instrument. HO (4.1)

The Thermo-Forces of Palladium, Iron and Palladium-Silver Alloys Charged with Hydrogen. (Ueber die thermokräfte von mit Wasserstoff beladenem Palladium, Eisen und Palladium-Silberlegierungen.) ROLF NUEGEL. *Annalen Physik*, Series 5, Vol. 9, 1931, pages 826-838.

The thermo-force of these materials is strongly influenced by the amount of hydrogen in the metal. The alloy palladium-silver has a pronounced maximum of the thermo-force at 40% silver. Test methods and results are described. Ha (4.1)

Changes in Electrical Resistance due to Magnetism and Hardness. S. R. WILLIAMS & R. A. SANDERSON. *Physical Review*, Vol. 37, March 1931, pages 309-314.

Eleven nickel samples were tested with respect to the influence of a magnetic field on the specific resistance. Different hardness had no influence on the latter, but the increase of resistance in the magnetic field decreased rapidly with increasing hardness. Also the magnetostriction (changes of length in the magnetic field) decreased with increasing hardness. Ha (4.1)

Disturbances by Harmonics in Bridge-Measurements. (Störungen durch Oberwellen bei Brückenmessungen.) W. DETTMAR. *Archiv Elektrotechnik*, Vol. 25, August 1931, pages 537-543.

Attention is called to the fact that small angular measurements (as f.i power factor of condensers) are measured correctly only if pure sine waves are used in the bridge. If this is not the case considerable deviations from the true value may be found as illustrated in several examples. Ha (4.1)

Wheatstone Bridge for Measuring Solid and Liquid Resistances; in Testing of Lightning Arresters and for Location of Faults. (Wheatstonische Messbrücke zur Messung fester und flüssiger Widerstande [Blitzableiter prüfung] sowie zu Fehlerortsbestimmungen.) *Elektrotechnische Zeitschrift*, Vol. 52, Aug. 20, 1931, page 1095.

A new compact circular arrangement of the measuring wires and detachable instrument on a plug socket by R. Abrahamsohn Berlin-Steglitz. Ha (4.1)

Electrical Instrument Progress. H. C. JOLLEY. *Electrical Engineering*, Jan. 8, 1932, pages 43-45.

Describes instruments shown at the annual exhibition of the Physical and Optical Societies. Includes automatic controllers, photo-electric relay system of galvanometer measurements, radiation balance, electric clocks, harmonic detectors, indicators and recorders, quartz-controlled wavemeters, deflectional frequency indicators, oscillograph [illegible] MS (4.1)

Measuring High Voltages. W. M. THORNTON & W. [illegible] SON. *Electrical Review*, Jan. 22, 1932, page 122.

Abstract of a paper read before the Institution of Electrical Engineers. Method is based on the fact that an ellipsoid suspended between plane vertical metallic surfaces at different potentials is polarized by the field and, if placed at an angle to it, experiences a torque which brings it into line. The magnitude of this torque can be calculated when the material and dimensions of the ellipsoid and the intensity of the undisturbed field are known, and can be observed either by static deflections or by allowing the suspended body to make small swings about a position of rest in line with the field. Method is capable of great accuracy, which depends largely on the perfection of form of the ellipsoids. Working formula of the instrument is $F = k\,(n^2 - n^2_0)\,l_2$, where F is the field strength, k, a constant found from the dimensions, n, the number of swings per sec. of the ellipsoid with the field on, and n_0 with it off. Method is suitable only for voltages high enough to maintain a field of several hundred volts per cm. at the center of the space between the plates, while at the same time the ratio of distance between plates to length of the ellipsoid should be not less than 25 if an accuracy above 1 in 1000 is desired. MS (4.1)

An Electrostatic Voltmeter. WARREN W. NICHOLAS. *Bureau of Standards Journal of Research*, Vol. 8, Jan. 1932, pages 111-118.

An electrostatic voltmeter possessing several unique features is described. The size is a minimum for such instruments, since the potential difference is applied to two electrodes, the geometrical arrangement of which is analogous to concentric spheres. The inner electrode is supported on the end of an insulating bushing introduced through the outer electrode, which is a metal can. The inner electrode contains a suspended dumb-bell rotated by electrostatic repulsion, as in the Coulomb torsion balance. The deflection is read by means of a mirror, which, for convenience in mounting the instrument at a safe height, may be placed at the lower end of the insulating bushing. For purposes of automatic control, the dumb-bell may be connected mechanically with an apparatus at ground potential. The design may be adapted to the use of high pressure gases, desirable in the measurement of very high voltages. The sensitivity of the instrument is discussed and calibration curves given for various suspensions. WAT (4.1)

The Distribution of the Electrical Field in the Arcs of Electric Furnaces with Interrupted Operation for the Melting of Steel. (Ueber die Verteilung des elektrischen Feldes in den Lichtbögen elektrischer Öfen mit unterbrochenem Betrieb zur Erschmelzung von Stahl.) G. AGOSTINELLI. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, page 923.

A method is described to determine from the physical properties of the electric arc the distribution of the potential and of the electric field in all positions of the electrodes by means of an elliptical coordinate system. The influence of the magnetic field in a furnace with three electrodes is investigated with an oscillograph. Ha (4.1)

Relations between Hall Effect and Resistance. F. W. WARBURTON & J. W. TODD. *Physical Review*, Vol. 37, June 1931, page 775.

Thin gold films show the same relation between the electric resistance and the Hall effect as has been observed for tellurium for temperatures between room temperature and 100° C. The phenomenon is explained by conduction of electrons. Ha (4.1)

A Simple Experiment to Demonstrate and Investigate the Peltier Effect. (Ein einfacher Versuch zur Demonstration und Untersuchung des Peltiereffekts.) U. PH. LELY. *Zeitschrift für Physik*, Vol. 70, July 14, 1931, pages 562-563.

A rod of three equal pieces, the center of iron and the two ends of copper is heated once by direct current and the second time by alternating. If, after disconnecting the current, the rod is connected to a galvanometer, the latter will show a deflection only after heating with direct current which is due to the Peltier effect which can not be observed with alternating current. Ha (4.1)

Electrical Measurement Developments in 1931. E. S. LINCOLN. *Instruments*, Vol. 5, Jan. 1932, pages 11-13, 14.

Reviews developments of the year, and finds that "the development of new instruments has been confined principally to those measuring non-electrical quantities, but using electricity as a means." What development there was in electrical instruments was confined to refinement of details and accuracy, with no radical departures from principles already established. Ho (4.1)

Meg Ground Tester. JAMES G. BIDDLE COMPANY. *Instruments*, Vol. 5, Feb. 1932, page 56.

This new ground tester is an adaptation of the existing "Megger" ground tester. Ground resistance is measured with alternating current generated by a self-contained generator. Ho (4.1)

Clip-on Ammeter. FERRANTI, INC. *Instruments*, Vol. 5, Feb. 1932, page 54.

This clip-on ammeter is a conbined hinged-core current transformer and double range milliammeter calibrated to read directly in amperes. Ho (4.1)

Three-Phase Power and Power Factor Computation. C. ALBERT KULMANN *Electrical West*, Jan. 1, 1932, page 29.

Presents a nomograph for computing power factor and total power by the two-wattmeter method. MS (4.1)

Circuit Tester. ROLLER-SMITH CO. *Instruments*, Vol. 5, Jan. 1932, page 24.

Resistance is read directly in ohms on the scale of the instrument. Embodied in the instrument is a small dry cell in series with a high (10,000 ohm) resistance galvanometer. Ho (4.1)

Differential Pressure
Bailey Meter Co.
Brown Instrument Co.
Foxboro Co.
Hays Corporation
Morey & Jones, Ltd.
Tagliabue Mfg. Co., C. J.

Draft
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Ellison Draft Gage Co.
Foxboro Co.
Hays Corporation
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Drill
Bausch & Lomb Optical Co.

Flow
Bailey Meter Co.
Morey & Jones, Ltd.

Grinding

Liquid Level
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Ellison Draft Gage Co.
Foxboro Co.
Morey & Jones, Ltd.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Loss of Head
Bailey Meter Co.
Bristol Company.
Brown Instrument Co.
Foxboro Co.
Morey & Jones, Ltd.

Pitch Diameter
R. Y. Ferner Co.

Pocket

Pressure
Bailey Meter Co
Bristol Company
Brown Instrument Co.
Foxboro Co.
Alfred Suter
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Pressure-Temperature
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Pressure & Vacuum
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Profile
Bausch & Lomb Optical Co.

Rain
Taylor Instrument Companies

Recording—Distance
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

Strain
Baldwin-Southwark Corp.
Alfred Suter

Tester
Baldwin-Southwark Corp.

Thickness
R. Y. Ferner Co.

Vacuum
General Electric Co.

Volume
Brown Instrument Co.
Foxboro Co.

Water Level for Boilers
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Foxboro Co.

Wind
Bristol Company
Brown Instrument Co.
Taylor Instrument Companies

GALVANOMETERS
Brown Instrument Co.
General Radio Co.
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.

GAS ANALYTICAL METERS
Chemical
Hays Corporation
Tagliabue Mfg. Co., C. J.
Electrical
Brown Instrument Co.

GAS LEAK INDICATORS
Taylor Instrument Companies

GAS-METERS
Bailey Meter Co.
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.

GOVERNORS
Pressure
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Tagliabue Mfg. Co., C. J.
Pump
Bailey Meter Co.
Tagliabue Mfg. Co., C. J.

GLASS BLOWERS' GOGGLES
Burgess-Parr Co.

GREASE TESTING APPARATUS
Tagliabue Mfg. Co., C. J.

GROUND DETECTORS
Rubicon Company
Weston Elec. Inst. Corp.

GYPSUM TESTING INSTRUMENTS
Alfred Suter

HAND TALLEYS
Veeder-Root, Inc.

HARDNESS TESTERS
Baldwin-Southwark Corp.
Alfred Suter

HELIOSTATS
Gaertner Scientific Corp.

HIGH FREQUENCY APPARATUS
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.

HIGH VOLTAGE
Fuses
Littelfuse Laboratories
Indicators
Weston Elec. Inst. Corp.
Measuring Devices
General Electric Co.
Weston Elec. Inst. Corp.
Testing Devices
General Electric Co.

HUB ODOMETERS
Veeder-Root, Inc.

HUMIDITY CONTROLLERS
Bristol Company
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

HUMIDITY RECORDERS
Wet & Dry Bulb Thermometers
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

HYDROGEN APPARATUS
Hellige, Inc.

HYDROGEN ION METERS
Indicating
Rubicon Company

HYDROMETERS
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

HYGROMETERS
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies

ILLUMINOMETERS
Weston Elec. Inst. Corp.

IMPACT HARDNESS TESTER
Alfred Suter

IMPACT TESTING MACHINES
Alfred Suter

INDICATORS—See Gages

INDUCTANCES
General Radio Co.
Rubicon Company

INSTRUMENT CALIBRATION AND REPAIRS
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.

INSTRUMENT FUSES
Littelfuse Laboratories

INSTRUMENT TRANSFORMERS
General Electric Co.
Weston Elec. Inst. Corp.

INSULATION TESTING EQUIPMENT
General Electric Co.
Rubicon Company

INTERFEROMETERS
Gaertner Scientific Corp.

KEYS AND SWITCHES
General Radio Co.
Rubicon Company

KEYSTROKE COUNTERS (for Typewriters, etc.)
Veeder-Root, Inc.

KILNBOY
Foxboro Co.

LABORATORY RHEOSTATS
Ward Leonard Elec. Co.

LACTOMETERS
Tagliabue Mfg. Co., C. J.
Taylor Instrument Cos.

LENGTH MEASURING MACHINES
R. Y. Ferner Co.
Gaertner Scientific Corp.

LEVELS
Centering
Bausch & Lomb Optical Co.
R. Y. Ferner Co.
Engineer's, Wye, Precision, Prism
R. Y. Ferner Co.
Taylor Instrument Companies

LOCOMOTIVE INDICATORS
Baldwin-Southwark Corp.

MAGNETIC RELAYS
Ward Leonard Elec. Co.

MAGNETOMETERS
Rubicon Company

MANOMETERS
Bailey Meter Co.
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Hays Corporation
Morey & Jones, Ltd.
Alfred Suter

MASTER CLOCKS
Gaertner Scientific Corp.

MEGOHMMETERS
Rubicon Company

MEGOHM VOLTMETERS
Weston Elec. Inst. Corp.

MELTING POINT APPARATUS
Burgess Parr Co.
Tagliabue Mfg. Co., C. J.

MICROAMMETERS
General Electric Co.
Rawson Electrical Instrument Co.
Weston Elec. Inst. Corp.

MICROFARADMETERS
General Radio Co.
Rubicon Company
Weston Elec. Inst. Corp.

MICROMETERS
R. Y. Ferner Co.
Gaertner Scientific Corp.

MICROSCOPES
Brinell
Bausch & Lomb Optical Co.
Gaertner Scientific Corp.
Alfred Suter
Measuring
R. Y. Ferner Co.
Metallographic
Bausch & Lomb Optical Co.
Petrographical
Bausch & Lomb Optical Co.
Toolmakers'
Bausch & Lomb Optical Co.
Gaertner Scientific Corp.

MICROTOMES
Bausch & Lomb Optical Co.

MILLIAMMETERS
Bristol Company
General Electric Co.
General Radio Co.
Rawson Elec. Inst. Co.
Weston Elec. Inst. Corp.

MILLIVOLTMETERS
Bristol Company
Brown Instrument Co.
General Electric Co.
Rawson Electrical Inst. Co.
Taylor Inst. Companies
Weston Elec. Inst. Corp.

MORRORS
Hellige, Inc.

MODULATION METERS
Weston Elec. Inst. Corp.

MOISTURE METERS
Tagliabue Mfg. Co., C. J.

MOTION RECORDERS
Mechanical
Baldwin-Southwark Corp.
Bristol Company
Foxboro Co.

MOTOR STARTERS
Ward Leonard Elec. Co.

MULTIMETERS
Rawson Elec. Inst. Co.

MULTIPLE PEN RECORDER
Baldwin-Southwark Corp.
Foxboro Co.

MULTIPLIERS
Weston Elec. Inst. Corp.

OHM METERS
General Radio Co.
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.

OIL TESTING APPARATUS
General Electric Co.
Tagliabue Mfg. Co., C. J.
Taylor Inst. Companies

OPERATION RECORDERS
Electrical
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.

ORIFICE METERS
Indicating
Bailey Meter Co.
Defender Automatic Regulator Co.
Morey & Jones, Ltd.
Indicating & Recording
Bailey Meter Co.
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.

ORSAT APPARATUS
Hays Corporation

OSCILLATORS
Weston Elec. Inst. Corp.

OSCILLOGRAPHS
Baldwin-Southwark Corp.
General Electric Co.
General Radio Co.
Hellige, Inc.

OXYGEN RECORDERS
Hays Corporation
Tagliabue Mfg. Co., C. J.

PANTOGRAPHS
Gaertner Scientific Corp.

PERISCOPES
Bausch & Lomb Optical Co.
Gaertner Scientific Corp.

PERMEAMETERS
Rubicon Company

PHOTO-ELECTRIC CELLS
General Electric Co.
Weston Elec. Inst. Corp.

PHOTO-ELECTRIC COLOR ANALYZERS
General Electric Co.

PHOTO-ELECTRIC COLOR COMPARATORS
General Electric Co.

PHOTOMETERS
Gaertner Scientific Corp.
Bausch & Lomb Optical Co.

PHOTO-MICROGRAPHIC EQUIP.
Bausch & Lomb Optical Co.

PHYSICAL TESTING MACHINES
Baldwin-Southwark Corp.
Alfred Suter

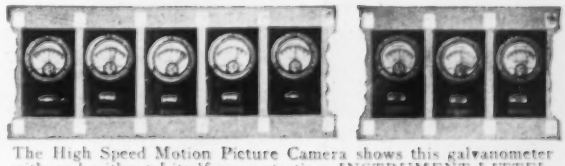
PITOT TUBE METER
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.

PLANIMETERS
Automatic Flow Record
Brown Instrument Co.
Foxboro Company
Linear
Brown Inst. Co.
Baldwin-Southwark Corp.
Radial
Bailey Meter Co.
Bristol Company
Foxboro Co.
Square Root
Foxboro Company

POLARISCOPES
Bausch & Lomb Optical Co.
Gaertner Scientific Corp.
Hellige, Inc.

POSITION RECORDERS
Bristol Company
Foxboro Co.
Tagliabue Mfg. Co., C. J.

SAFE vs SORRY



The High Speed Motion Picture Camera shows this galvanometer with and without Littelfuse protection. INSTRUMENT LITTELFUSES are made in 1/100, 1/32, 1/16, ⅛, ¼, ⅜, ½, ¾, 1 and 2 amps. capacity. Also made in 1000, 5000 and 10,000 volt ranges. Quick, accurate and inexpensive.

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Disturbance Recorder for Power Distribution Systems. (Störungsschreiber für Starkstromnetze.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section J036-1, pages T90-91.

These instruments are to record not only the time of a failure, but also the magnitude and especially the course of the disturbing phenomenon so that means can be devised to eliminate such failures. Instruments used for this purpose are mostly oscillographs; the operation and evaluation is explained by an oscillographic record. Firms building such instruments are enumerated and the working principles of their instruments briefly described. Ha (4.2)

Portable Balance Unit for A-C Precision Bridge. S. J. Zammataro. *Bell Laboratories Record*, Vol. 10, Jan. 1932, pages 173-177.

Description of the mechanical construction and electrical connections. Ha (4.2)

Electrical Integration of Industrial Heat Quantities with Resistance-Remote Transmitters and Induction Meters Independent of Voltage. (Electrische Integrierung Warmetechnischer Messgropen mit Widerstandsfernsendern und spannungsunabhängigen Induktionszählern.) W. Geyger. *Archiv für Elektrotechnik*, Vol. 26, Feb. 23, 1932, pages 94-98.

A new differential connection of the meter is described which assures a correct proportionality over the whole measuring range and avoids a possible over-compensation of the meter; the usual bridge or voltage-divider connections give only an approximate proportionality between meter current and quantity to be measured. Ha (4.2)

Constant Wattage Voltage Regulator. Ward Leonard Electric Co. *Instruments*, Vol. 5, Feb. 1932, page 60.

Combined in this unit are a voltage transformer and regulator reducing the alternating current line voltage to that required by the exciter lamp, and maintaining the exciter lamp voltage constant regardless of fluctuatfons in line voltage.

The design of the regulator is such as to compensate for commercial manufacturing variations in lamps of the same nominal rating and to correct for the increase in lamp resistance with aging. Ho (4.2)

An Improved High Resistance Unit. H. C. Rentschler & D. E. Henry. *Review of Scientific Instruments*, Vol. 3, Feb. 1932, pages 91-92.

A resistance of from a few megohms to several hundred thousand megohms is produced by sputtering carbon or graphite onto a glass spiral in an inert gas; such resistances proved to be very constant; they are sealed into standard tubes with normal sockets. Ha (4.2)

Electrical Instruments in the Gas Industry. E. X. Schmidt. *Electrical Engineering*, Vol. 51, March 1932, page 189.

The most recent developments in electrical instruments for measurement of gas flow, calorimeter, heating values, etc., are reviewed. Ha (4.2)

Remote Control System, Without Pilot Wire, Over Electric Distribution Networks, for Electrical Equipment and Metering Apparatus. (Système d'action à distance pour la commande, sans fil pilote, sur les réseaux de distribution d'énergie électrique, des apparells de tarification et d'utilisation.) M. Chirol. *Revue Générale de l'Electricite*, Nov. 14, 1931, pages 795-805.

Principle of the system described depends on the utilization of medium-frequency currents which are superposed on the principal low-frequency current transmitted by the network lines. Describes both transmitting and receiving apparatus manufactured by the Compagnie pour la Fabrication des Compteurs et Matériel d'Usines a Gaz. MS (4.2)

A Generating Voltmeter for the Measurement of High Potentials. P. Kirkpatrick & Iwao Miyake. *Review of Scientific Instruments*, Vol. 3, Jan. 1932, pages 1-8.

The instrument is in principal a simple armature with a two part commutator rotating in an electrostatic field, connected to a galvanometer for measuring the generated current. If the armature is driven at an angular velocity of n revolutions per second the average current through the galvanometer is $I = 2CVn$, where C is the capacitance of the armature, and V the potential of the electrostatic field. The range of the instrument extends from zero to an indefinitely high voltage depending on the clearances in the construction, it draws no current from high-voltage source, the armature moving only electric-charges. The construction is simple and can be made for about $25. The calibration is constant and temperature effects are negligible. Ha (4.2)

Amplitude Measurement of Pulsating Direct Current Voltage with Static Voltmeter and Rectifier Tube. (Scheitelwertmessung pulsierender Gleichspannung mit statischen Voltmeter und Ventilröhre.) W. Cames. *Archiv für Elektrotechnik*; Vol. 26; Feb. 23, 1932, pages 127-130.

The test results of measurements of the maximum amplitude of various voltage curves up to 120 KV are reproduced which were made with this method for comparison with measurements by oscillograph and ohmic resistance. The agreement between the two methods is good. Ha (4.2)

Small Measuring Bridge. *Power*, Vol. 75; Jan. 12, 1932, pages 76-77.

A battery-type measuring bridge of 10,000 and 50,000 ohms is illustrated. AHE (4.2)

The Siemens Disturbance Recorder. (Der Siemens-Störungsschreiber.) W. Hofmann & P. M. Pflier. *Siemens-Zeitschrift*, Vol. 11, July 1931, pages 325-333.

For the analysis of disturbances a record following absolutely all phases is imperative; the instrument for such purpose must possess therefore a very short time of adjusting itself and a good damping of the measuring system; besides it must, under ordinary operating conditions be always ready and simple in handling. The disturbance recorder described in the paper has a natural frequency of 65 cycles/sec. with a time for one half wave of 0.077 seconds. The apparatus contains three moving-coil measuring devices arranged side by side. The function of the apparatus is explained on the example of a ground-detector. Ha (4.2)

Highly Magnetic Alloys of Nickel-Iron. (Hochmagnetische Legierungen aus Nickel-Eisen.) Geo. Keinath. *Archiv für Technisches Messen*, 1931, section Z913-1, page T63.

The highly magnetic alloys are distinguished from ordinary magnetic material by their high initial permeability, high maximum permeability, and constant permeability. The most known types are: Permalloy, 78.5% Ni, 21.5% Fe; a thermically less sensitive modification is 78.5% Ni, 18% Fe, 3.5% Mo. Hipernik, 50% Ni, 50% Fe, maximum permeability = 167,000. Mumetal, Rhometal, Megapermalloy, Perminorm, Perminvar are others of more or less similar composition. The heat treatment is of great importance for maintaining constancy of the good magnetic qualities, especially for coercive force, maximum magnetizability, specific resistance and magnetic losses for alternating current are given. The influence of mechanical stresses is discussed.

The Changes of Electric Conductivity of Ferromagnetic Materials in Magnetic Fields. (Die Aenderungen der Elektrischen Leitfähigkeit Ferromagnetischer Stoffe in Magnetfeldern.) O. Steierstadt. *Zeitschrift Technische Physik*, Vol. 13, 1932, pages 65-71.

The apparatus and methods used in the tests and the theory of the measuring methods are explained and a few hysteresis curves in magnetic fields for several materials are reproduced. The author shows that not the exterior magnetic field defines the physical condition of a ferro-magnetic material but the interior field, the magnetic induction or the magnetization. For a theoretical explanation the magnetization curve B-f (h) must be plotted together with the change of resistance and the changes be represented as function of the inner field B. The virginal magnetization curve can then be expressed very closely by $dw/w = cxi^{2n}$, the exponent x for iron and nickel lies between 3 and 4, the constant c is of the order 10^{-25} to 10^{-26}. Ha (4.4)

Magnetic Materials in the Year 1931. T. D. Yensen. *Paper read before the American Iron and Steel Institute*, New York, Oct. 23, 1931, 31 pages.

The author reviews briefly the present theoretical views of the nature of ferro-magnetism and the effect of impurities; it is shown how the results from these considerations have lead to the high-grade magnetic irons; their equilibrium diagrams are discussed. It is pointed out that the discrepancy between the theoretical curves for ferromagnetic materials and the early experimental curves were due to impurities and other factors which distort the crystal lattice. The development of methods of controlling these factors by means of new methods of analysis and new metallurgical processes it will be possible to produce magnetic materials to suit all requirements of practical application. Thirty references are cited. Ha (4.4)

Simple Method of Investigating the Magnetic Field of Conductors of Any Shape of Section Through Which a Current Flows. (Einfaches Verfahren zur Untersuchung des magnetischen Feldes stromdurchflossener Leitersysteme von beliebiger Querschnittsform.) W. Kraemer. *Elektrotechnische Zeitschrift*, Vol. 53, Jan. 7, 1932, pages 9-10.

A mathematical-analytical method is described which permits in a simple manner the determination of direction and magnitude of the magnetic field around asymmetric conductors of ironless magnetic circuits. Ha (4.4)

The Permeability of Iron, Nickel and Cobalt between 10^5 and 10^7 Hertz. (Die Permeabilität von Eisen, Nickel und Kobalt zwischen 10^5 and 10^7 Hertz.) M. J. O. Strutt. *Zeitschrift für Physik*, Vol. 69, April 13, 1931, pages 632-658.

The tests were made at these frequencies between a few tenths and a few Gauss. In this range, the permeability of the three metals decreases slowly with increasing frequency; anomalies as previously assumed to exist at 100 m wave length could not be confirmed. Heat treatment of the iron does not show any influence. Ha (4.4)

Strain and Diamagnetic Susceptibility. H. E. Banta. *Physical Review*, Vol. 37, May 1931, pages 634-637.

Tests of the influence of mechanical lattice changes on the diamagnetic susceptibility of copper and silver showed that torsions and tensions up to the elastic limit do not cause any change of the susceptibilities. Such changes, however, are caused by different heat treatments. The test results are explained by thermodynamic considerations. Ha (4.4)

The Theory of Derivation in Detail of the Magnetization Curves of the Single Crystals. (Zur Theorie der Feinstruktur der Magnetisierungskurven der Einkristalle.) N. Akulow. *Zeitschrift für Physik*, Vol. 69, April 23, 1931, pages 78-99.

Previously developed methods are extended so that they permit a more exact calculation of the magnetization curves of single crystals. The values thus calculated for iron agree well with tests made by other investigators. Ha (4.4)

Magnetism in Discontinuous Media. L. W. McKeehan. *Reviews of Modern Physics, appendix to Physical Review*, Vol. 2, April 1930, pages 477-505.

The various theories of magnetism are reviewed and in particular the modern theory of ferromagnetic crystals is treated. Ha (4.4)

The Anisotropy of the Magnetization of Ferromagnetic Crystals. (Zur Anisotropie der Magnetisierung ferromagnetischer Kristalle.) F. Bloch & G. Gentile. *Zeitschrift für Physik*, Vol. 70, July 6, 1931, pages 395-408.

The paper discusses and calculates the dependence of the magnetizing energy on the direction of the crystal. Ha (4.4)

A Few Experiments on "Magnetic after-Effect." (Einige Versuche über die "Magnetische Nachwirkung.) H. Kramers. *Physikalische Zeitschrift*, Vol. 32, June 15, 1931, pages 472-480.

The time required by induction to reach its final value if the magnetizing field is suddenly applied was investigated for the high-permeable alloys (perminvar, permalloy, etc.). An empirical formula could be developed which determined the final value as function of magnetizing field, thickness of iron, specific electric resistance and the magnetization curve of the material. Ha (4.4)

POTENTIOMETERS—Indicating
Brown Instrument Co.
General Electric Co.
Hellige, Inc.
Rubicon Company
Recording & Controlling
Brown Instrument Co.
Standard Cell Comparing
Eppley Laboratory, Inc.
Feussner Type
Eppley Laboratory, Inc.
POWER FACTOR METERS
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Jewell Elec. Inst. Co.
Weston Elec. Inst. Corp.
PRESSURE RECORDERS
Bailey Meter Co.
Bristol Co.
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Cos.
PRISMS
Hellige, Inc.
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Foxboro Co.
Tagliabue Mfg. Co., C. J.
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PROTRACTOR
Optical
Bausch & Lomb Optical Co.
PSYCHROMETER
Recording
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Inst. Companies
Sling
Taylor Inst. Companies
PYRHELIOMETERS—
Weather Bureau Type
Eppley Laboratory, Inc.
PYROMETERS
Optical
Pyrometer Instrument Co.
Radiation
Indicating
Brown Instrument Co.
Pyrometer Instrument Co.
Taylor Instrument Companies
Recording
Brown Instrument Co.
Pyrometer Instrument Co.
Taylor Instrument Companies
Thermo-electric
Immersion
Bristol Company
Brown Instrument Co.
Foxboro Co.
Pyrometer Instrument Co.
Taylor Instrument Companies
Indicating
Bristol Company
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Taylor Instrument Companies
Recording and Controlling
Bristol Company
Brown Instrument Co.
Foxboro Co.
Taylor Instrument Companies
Surface Contact
Bristol Company
Brown Instrument Co.
Pyrometer Instrument Co.
Taylor Instrument Companies
RADIATION TUBES
Pyrometer Instrument Co.
RADIO FREQUENCY OSCILLATORS
General Radio Company
RADIO SET ANALYZERS
General Radio Company
Weston Elec. Inst. Corp.
RADIO TEST PANEL
Rubicon Company
Weston Elec. Inst. Corp.
RADIO TUBE CHECKERS
General Radio Company
Weston Elec. Inst. Corp.
REFRACTOMETERS
Bausch & Lomb Optical Co.
REGULATORS—See Controls
RELAYS
General Electric Co.
General Radio Co.
Ward Leonard Elec. Co.
Weston Elec. Inst. Corp.
Light Sensitive
Burgess Laboratories, Inc., C. F.
Weston Elec. Inst. Corp.
Vacuum Contact
Burgess Laboratories, Inc., C. F.
Vacuum Tube
Burgess Laboratories, Inc., C. F.
REMOTE METERING EQUIPMENT
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
General Electric Co.

RESISTANCE—Electrical
General Radio Co.
Rubicon Company
Ward Leonard Elec. Co.
RESISTANCE COILS
Ward Leonard Elec. Co.
RESISTOR UNITS
Ward Leonard Elec. Co.
"REV-METERS"
Veeder-Root, Inc.
RHEOSTATS
General Radio Company
Rubicon Company
Ward Leonard Elec. Co.
SACCHARIMETERS
Bausch & Lomb Optical Co.
Taylor Inst. Companies
SACCHAROMETERS
Tagliabue Mfg. Co., C. J.
SALINITY INDICATORS
Rubicon Company
SCALES
Gaertner Scientific Corp.
Alfred Suter
SEISMOGRAPHS
R. Y. Ferner Co.
SHUNT METERS
Bristol Co.
SHUNTS
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.
SIGNALING DEVICES—Automatic
Brown Instrument Co.
Foxboro Co.
Rubicon Company
SPECIAL COILS
Ward Leonard Elec. Co.
SPECIAL ELECTRICAL INSTRUMENTS
Bristol Co.
Brown Instrument Co.
General Radio Co.
Rawson Elec. Inst. Co.
Rubicon Company
Weston Elec. Inst. Corp.
SPECIAL INSTRUMENTS
Burgess Laboratories, Inc., C. F.
SPECIFIC GRAVITY APPARATUS—Gas
Hays Corporation
SPECTROGRAPHS
Bausch & Lomb Optical Co.
R. Y. Ferner Co.
Gaertner Scientific Corp.
SPECTROPHOTOMETERS
Bausch & Lomb Optical Co.
Gaertner Scientific Corp.
SPECTROSCOPES
Bausch & Lomb Optical Co.
R. Y. Ferner Co.
Gaertner Scientific Corp.
Hellige, Inc.
SPEED COUNTERS
Veeder-Root, Inc.
SPEED INDICATORS
See Tachometers
SPEED RECORDERS
Bristol Company
Brown Instrument Co.
SPEED REGULATORS
Ward Leonard Elec. Co.
STANDARD CELLS
Eppley Laboratory, Inc.
Weston Elec. Inst. Corp.
STOP WATCHES
R. Y. Ferner Co.
STRAIN GAGES
Baldwin Southwark Corp.
Alfred Suter
SULPHUR DETERMINATION APPARATUS
Burgess Laboratories, Inc., C. F.
Tagliabue Mfg. Co., C. J.
SULPHUR DIOXIDE METERS
Hays Corporation
Tagliabue Mfg. Co., C. J.
SUNSHINE RECORDERS
Taylor Instrument Companies
SURGE INDICATORS AND RECORDERS
General Electric Co.
SYNCHRONOSCOPES
Weston Elec. Inst. Corp.
SYNCHRONIZING FORKS—Electrical
General Radio Co.
TACHOGRAPH
Baldwin-Southwark Corp.
TACHOMETERS
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Foxboro Co.
Veeder-Root, Inc.
Weston Elec. Inst. Corp.
TACHOSCOPES
Brown Instrument Co.
TELEMETER
Baldwin-Southwark Corp.
TELESCOPES
Bausch & Lomb Optical Co.
R. Y. Ferner Co.
Gaertner Scientific Corp.

TENSILE TESTERS FOR PAPER, WIRE, SHEETS, ETC.
Alfred Suter
TENSOMETER (Huggenberger)
Baldwin-Southwark Corp.
TESTING MACHINES
Fatigue
Baldwin-Southwark Corp.
Alfred Suter
Impact
Baldwin-Southwark Corp.
Alfred Suter
Hardness
Baldwin-Southwark Corp.
Alfred Suter
Portable—Hardness
Alfred Suter
Portable—Tensile—Compression
Baldwin-Southwark Corp.
Alfred Suter
Sheet Metal
Alfred Suter
Baldwin-Southwark Corp.
Oil & Bearing
Baldwin-Southwark Corp.
Universal
Baldwin-Southwark Corp.
A. Suter
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A. Suter
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General Electric Co.
THERMO-JUNCTIONS (Electric)
General Radio Co.
Rawson Electrical Inst. Co.
THERMO-VOLTMETERS & AMMETERS
Weston Elec. Inst. Corp.
THERMOPILE—Coblenta Type
Eppley Laboratory, Inc.
THERMOMETERS
Gas Filled
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Company
Tagliabue Mfg. Co., C. J.
Taylor Inst. Companies
Mechanical
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Mercurial
Bristol Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
Resistance
Brown Instrument Co.
Foxboro Co.
Vapor-Tension
Bristol Company
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Inst. Companies
Wet & Dry Bulb
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
THERMOSTATS
Bristol Company
Brown Instrument Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
TIME INDICATORS
Baldwin-Southwark Corp.
TIME METERS
General Electric Co.
TIME OPERATION RECORDERS
Bristol Company
Foxboro Co.
Tagliabue Mfg. Co., C. J.
TIME RECORDERS
Bristol Company
Brown Instrument Co.
Gaertner Scientific Corp.
Foxboro Co.
Tagliabue Mfg. Co., C. J
TIME SWITCHES
General Electric Co.
TIMERS
Rawson Elec. Inst. Co.
Rubicon Company
TORSIOGRAPH
Baldwin-Southwark Corp.
TORSION MACHINES
Alfred Suter
TRANSFORMATION POINT RECORDERS
Brown Instrument Co.
TRANSFORMERS (Instrument)
General Electric Co.
General Radio Co.
Weston Electrical Inst. Corp.
TRANSITS
Engineer's, Surveyors, Mine
Gaertner Scientific Corp.
Pocket
Taylor Instrument Companies

TUNING FORKS—Electrically Driven
General Radio Co.
Gaertner Scientific Corp.
Rubicon Company
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Burgess-Parr Co.
Hellige, Inc.
U-TUBE MANOMETERS
Bailey Meter Co.
Defender Automatic Regulator Co.
Hays Corporation
Morey & Jones, Ltd.
VACUUM RECORDERS
Bailey Meter Co.
Bristol Company
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Cos.
VACUUM TUBE BRIDGES
General Radio Company
VACUUM TUBE RELAYS
Burgess Laboratories, Inc., C. F.
VACUUM TUBE VOLTMETERS
Rawson Elec. Inst. Co.
VALVES
Automatic Shut Off
Bristol Company
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Company
Tagliabue Mfg. Co., C. J.
Taylor Instrument Cos.
Balanced
Bailey Meter Co.
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Diaphragm
Bristol Company
Defender Automatic Regulator Co.
Foxboro Company
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
Electrically Operated
Bristol Company
Brown Instrument Co.
General Electric Co.
Reducing
Bailey Meter Co.
Tagliabue Mfg. Co., C. J.
Regulating
Bailey Meter Co.
Bristol Co.
Brown Instrument Co.
Defender Automatic Regulator Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
Taylor Instrument Companies
Safety, Fuel Shut-off
Tagliabue Mfg. Co., C. J.
VENTURI METERS
Bailey Meter Co.
Brown Instrument Co.
Foxboro Co.
VIBROGRAPH
Baldwin-Southwark Corp.
VIBROSCOPE
Baldwin-Southwark Corp.
VISCOSIMETERS
Tagliabue Mfg. Co.
Taylor Inst. Companies
VOLTAGE DIVIDERS
General Radio Co.
Rubicon Company
Ward Leonard Elec. Co.
VOLT-AMMETERS
General Electric Co.
Weston Elec. Inst. Corp.
VOLTMETERS
Electrostatic
Rawson Elec. Inst. Co.
Indicating
General Electric Co.
General Radio Co.
Rawson Electrical Inst. Co.
Weston Elec. Inst. Corp.
Recording
Bristol Company
General Electric Co.
Thermionic Rectifier
General Radio Co.
WATER METERS
Bailey Meter Co.
Foxboro Co.
Tagliabue Mfg. Co., C. J.
WATER & SEDIMENT APPARATUS
Tagliabue Mfg. Co., C. J.
WATTHOUR METERS
General Electric Co.
WATTMETERS
Indicating
General Electric Co.
Rawson Elec. Inst. Co.
Weston Elec. Inst. Corp.
Recording
Bristol Company
General Electric Co.
WAVEMETERS
General Radio Co.
WAX MELTING APPARATUS
Tagliabue Mfg. Co., C. J.

Radio Measurements (5.1)

An Improved Audio-Frequency Generator. E. G. Lapham. *Bureau of Standards Journal of Research*, Vol. 7, Oct. 1931, pages 691-695.

This paper describes in detail the construction of an audio-frequency generator for use in making radio-frequency measurements. The variable audio-frequency output is the beat note between two sources of radio-frequency; the one a piezo oscillator, and the other a variable oscillator. The output is continuously variable from 50 to 1500 cycles per second. The entire unit is assembled very compactly and the essential parts are mounted in a temperature-controlled compartment. The calibration curve is practically linear over an interval of 50 cycles per second, and repeated calibrations indicate that it is constant to better than 0.1 cycle per second over the entire range. WAT (5.1)

Quartz Plate Mountings and Temperature Control for Piezo Oscillators. Vincent E. Heaton & E. G. Lapham. *Bureau of Standards Journal of Research*, Vol. 7, Oct. 1931, pages 683-690.

In this paper are described a number of representative types of mountings for rectangular and circular quartz plates to be used for frequency standards. Unless the movement of the quartz plate in the holder is restricted, the frequency will change with each slight jar. A satisfactory holder for mounting a long rectangular plate to oscillate in its extensional mode may be made by clamping the plate centrally perpendicular to its length between two keys, one in the face of each electrode. The electrodes are spaced by quartz washers. A plate mounted in such a holder will be constant in frequency to 1 part in 300,000. Such a mounting has not been found satisfactory for frequencies above 100 kc as the damping caused by the pressure of the keys is too great. A very satisfactory holder for mounting a cylindrical quartz plate for "thickness oscillation" may be made by clamping the plate between three screws, mounted radially 120° apart in a ring so that they press into a V-shaped groove cut around the cylindrical surface of the quartz plate midway between the faces. The electrodes are spaced on either side of the quartz plate by pyrex washers. Mounted in such a way, the plate has been found to be constant in frequency to 1 part in 1,000,000 in a portable frequency standard with the addition of temperature control of the oscillating circuit. Some discussion is given the subject of temperature control of the piezo oscillator. WAT (5.1)

Constant Frequency Oscillators. F. B. Llewellyn. *Bell Telephone System Technical Publications*, Monograph B-640, 1932, 34 pages.

The manner in which the frequency of vacuum tube oscillators depend upon the operating voltages is discussed. The theory of the dependence is derived and is shown to indicate methods of causing the frequency to be independent of the operating voltages. These methods are applied in detail to the more commonly used oscillator circuits. Experimental data are cited which show the degree of frequency stability which may be expected as a result of application of the methods outlined in the theory, and also show that the best adjustment is in substantial agreement with that predicted by theory. With a carefully built and adjusted oscillator the effects of normal variations in the operating voltages are negligible in comparison with the effects of temperature variations resulting from the changed operating currents. Methods of preventing these latter effects are not discussed in the present paper. The appendix contains an analysis of the conditions under which the performance of an oscillator may be represented by the use of linear circuit equations. WAT (5.1)

Regeneration Theory. H. Nyquist. *Bell Telephone System Technical Publications*, Monograph B-642, 1932, 22 pages.

Regeneration or feed-back is of considerable importance in many applications of vacuum tubes. The most obvious example is that of vacuum tube oscillators, where the feed-back is carried beyond the singing point. Another application is the 21-circuit test of balance, in which the current due to the unbalance between two impedances is fed back, the gain being increased until singing occurs. Still other applications are cases where portions of the output current of amplifiers are fed back to the input either unintentionally or by design. For the purpose of investigating the stability of such devices they may be looked on as amplifiers whose output is connected to the input through a transformer. This paper deals with the theory of stability of such systems. WAT (5.1)

Thermal Current Meter for High Frequencies. (Thermischer Strommesser für Hochfrequenz.) K. Schlesinger. *Elektrotechnische Zeitschrift*, Vol. 53, Jan. 7, 1932, pages 17-18.

The instrument is based on the expansion by the heat of the current of a platinum or tungsten wire. Not the elongation of the wire, but the change of frequency of the natural oscillation of the wire due to its changed length is measured by means of vibrations of a suitable vibrator, the frequency of which can be regulated and brought to resonance with the vibrating wire. Currents of less than 10 milliamp. can be measured. Ha (5.1)

An Efficient Equipment for Measurements on the Heaviside-Layers. (Eine leistungsfähige Einrichtung für Messungen an den Heaviside-schichten.) H. Rukop & P. Wolf. *Zeitschrift für Technische Physik*, Vol. 13, 1932, pages 132-134.

The height of the Heaviside layers is measured by means of the echos of wireless signals emitted by a rotating glow-tube and photographic records. The wave length of the signals is of the order of 10^6 Hertz, their duration 0.0001 second and the separation of signals 1/25 second. The sending power is 15 watts, and vertical reflection on the layers is used as sending and receiving stations are fairly close together. The apparatus operates automatically and records time vs. apparent height as coordinates. An example of two hours duration with its record is reproduced showing an upper Heaviside layer at about 400 km at sunrise which drops later to 230 km, and a lower layer at about 100 km thus corroborating the previously observed duplicity of the Heaviside Layer. Ha (5.1)

Electronic Measurements, Tubes, Devices and Their Applica... (5.4)

Oscillations in Discharge Tubes and Allied Phe...mena. J. J. Thompson. *Philosophical Magazine and Journal of ...* Series 7, Vol. 11, Mar. 1931, pages 697-735.

The behavior of an ionized gas under the conditi... ing in a discharge tube is theoretically investigated. ... periments are described to investigate the effects b... of a rapidly rotating mirror. Ha (5.4)

Thermionic Control. Bert S. Burkl. *Electrical W...* 1932, page 32.

Lighting in the Los Angeles Theatre is controll... newly developed Westinghouse thermionic-tube-c... theatre dimming switchboard. Operation consists in ... the load circuit from the lights through a standard re... dimmer. Changing reactance coil saturation varies th... ing circuit reactance. This coil saturation is chang... varying the d-c. potential through a third coil on th... mer, the direct current being supplied in turn to the ... by the vacuum-tube control unit. The output of this ... varied by a potentiometer on the stage or auditorium ... board. The sliding arm of the potentiometer is ... connected to the control tube grid, and by varying the po... tential on this grid from 0 to 30 volts, the output is varied from maximum to minimum. MS (5.4)

Traveling Waves and Cathode-Ray Oscillograph. (Ondes mobiles et l'oscillographe cathodique.) S. Teazner. *Revue Générale de l'Électricité*, Dec. 12, 1931, pages 957-966.

Develops considerations which led author to modify the Dufour cathode-ray oscillograph in order to adapt it to recording of rapid, aperiodic phenomena, particularly to steep-fronted traveling waves. Reviews work done previously and after outlining the principle of the cathode-ray oscillograph, indicates the changes which he made to various parts of the apparatus, chiefly those for improving recording conditions. Discusses method adopted for producing the sweep of the cathode beam and for assuring perfect synchronism between the displacement of the beam and the phenomena studied. Gives some typical results obtained in the form of oscillograms to show the possibilities of the improved instrument. MS (5.4)

A Corona Tube Voltage Regulator. H. W. Dobay & C. H. Willis. *Electrical Engineering*, Vol. 51, Feb. 1932, pages 112-114.

It is shown that a corona discharge tube consisting of two symmetrical electrodes sealed into a glass tube containing an inert gas at suitable pressure is particularly adapted for a control instrument due to the fact that the tube contains a definite quantity of gas in a fixed volume so that the mean free path of an ion and therefore the corona voltage are independent of temperature. The connection of such arrangement and regulating curves are given. Ha (5.4)

Photoelectric Recorder has High Sensitivity. C. W. La Pierre. *Electrical Engineering*, Vol. 51, Feb. 1932, pages 114-116; Vol. 75, May 17, 1932, pages 741-743.

A new recorder has been developed which employs for the measuring and recording operations separate elements coupled together by a combined optical and photoelectric system. The new instrument has been shown in tests to be as accurate, sensitive, and responsive as a good indicating instrument. The instrument is self-contained and requires 115 volts at 60 cycles. AHE – Ha (5.4)

A General Method of Gaseous Tube Control. C. Stassen. *Electrical Engineering*, Vol. 51, Mar. 1932, pages 188-189.

Methods were devised for the control of mercury vapor rectifiers by means of the hot cathode grid and it is shown that the inherent rectifying property of the cathode grid circuit lends itself to condenser-energy-storage methods of grid control in several ways. Some methods are described. Ha (5.4)

Rare Metal Thallium is Finding New Uses. *Steel*, Vol. 89, Aug. 29, 1931, page 38.

Physical and chemical properties of thallium are similar to lead; alloys of these two metals, contrary to other alloys, have a higher melting point than either of the components. A thallium-tin-lead alloy is resistant to sulphuric, nitric and hydrochloric acids. It is used also for optical glasses with a high refractive index, and in light-sensitive cells. Ha (5.4)

Photoelectric Tubes Control Sheet Mill Run Cut Tables. A. F. Bowers. *Steel*, Vol. 89, No. 8, Aug. 29, 1931, page 38.

The layout of the installation is described. Ha (5.4)

A Thyratron Voltage Regulator for an Alternator. Clarence E. Weinland. *Review of Scientific Instruments*, Vol. 3, Jan. 1932, pages 9-19.

A bridge circuit of dissimilar resistance acts as voltage-sensitive element to operate the thyratron of grid-controlled mercury arc rectifier for the proper excitation of a small 12.5 KVA motor-generator. Test curves and 17 references are given. Ha (5.4)

An Electrolytic Method of Producing Alkali Metals in Discharge Tubes. (Eine elektrolytische Darstellungsmethode von Alkalimetallen in Entladungsröhren.) M. Ferro & E. Patat. *Zeitschrift Technische Physik*, Vol. 12, May 1931, pages 256-262.

A method is described by which sodium, potassium, rubidium, and Caesium can be produced electrolytically as cathode in a vacuum and in a purity which makes them suitable for use in photocells. Ha (5.4)

The Characteristic of Electron Tubes. (Die Kennlinie der Elektronenröhren.) A. Gehrts. *Zeitschrift für Technische Physik*, Vol. 13, 1932, pages 117-122.

The electron current which flows in cylindrical glow-cathode single grid tubes (with negative grid voltage) can be calculated from the space-charge law of Langmuir-Schottky. As effective voltage of equipotential cathodes which have the same temperature, the algebraic sum of the effective voltage, the Volta-voltage, the border voltage and the correction factor for the natural velocities of electrons is to be taken. The influence of the voltage drop along the cathode can be graphically taken into account. The method is fully developed and demonstrated by the calculation of the characteristic of the RE 16 tube. Ha (5.4)

Spectrometry (7.5)
Photography (7.6)
Microscopy (7.7)
Electromagnetic Rays (This heading covers all electromagnetic rays other than visible light: infra-red, heat rays, ultra-violet, X-rays, alpha, beta, gamma, cathode, and cosmic rays.) **(7.8)**

CHEMISTRY (8)
Under this heading will be chemical measurements, analysis, and their control applications.

ASTRONOMY, NAVIGATION, AVIATION (9)
Included in this section will be, besides usual matters concerning astronomy, navigation and aviation, special matter on direction-control such as range finding, direction finding, radio beacons, etc.

GEODESY, GEOLOGY (10)
In this section will be covered seismology, geophysical prospecting methods, etc.

INSTRUMENT DESIGN and CONSTRUCTION (11)
Matters concerning new instruments, their design, operation and manufacture, will be included under this heading.

GENERAL and MISCELLANEOUS (12)
This section will include: First; general items of interest to all in the field of measurement and control. Example—"Possibilities of Vacuum Tubes for Application to Measurement and Control" is an article of universal interest in the fields of measurement and control. Second; miscellaneous items of general interest because not includable under any of the above classifications. Finally, items of general interest to all fields of measurement and control, such as historical material, biographical, etc.

General (of interest to all in measurement or control fields) **(12.1)**
Miscellaneous (12.2)
Historical and Biographical (12.3)
Bibliographical (12.4)
Economic (12.5)

CONTROL FUNCTIONING EQUIPMENT (13)
Literature on the equipment used by operators or automatic controllers to perform their control functions will be covered under this heading. For example, the drum controller and associated switches, rheostats, relays, and motor starters by which an operator controls the motion of a crane are all pieces of "control functioning equipment."
Mechanical Control Functioning Equipment (13.1)
Electrical Control Functioning Equipment (13.2)
Includes drum controllers, relays, solenoids, etc.

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INSTRUMENTS EMPLOYMENT SERVICE

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MEN AVAILABLE

INSTRUMENT MAKER: 3½ years experimental laboratory of lamp company; 2 years experimental laboratory of electrical company. J-2.

PYROMETER MAN: Graduate Pennsylvania State College. Had charge of pyrometer calibration laboratory in plant with 1100 pyrometers. J-3.

ELECTRICAL ENGINEER: Graduate Charlottenburg Technische Hochschule; 8 years research engineer with chemical company; 4 years steel plant electrical engineer; can read German, French, Spanish and Italian. J-6.

INSTRUMENT SALESMAN: Mechanican Engineering Graduate; experienced sales and service most type of power plant instruments. District Sales Manager 5 years. Experience on gages, flow meter, CO_2 recorders, pyrometers and other testing equipment. J-8.

PYROMETER MAN: 8 years experience; expert electrician and gage (hydraulic, pressure, vacuum, etc.) service man; 3 years instrument laboratory; education equivalent two years of engineering college. J-9.

INSTRUMENT ENGINEER: Graduate Engineering College. Charge of instrument department in large industrial plant for 2½ years. J-10.

RADIO OPERATOR: Graduate Dodge Institute, 1917. Commercial license either broadcast or telegraph. J-12.

INSTRUMENT SALESMAN: Graduate M.E., 4 years control instruments, 2 years power plant specialties, 4 years manufacturing experience, in shop. Now N. Y. District Mgr. large rolling mill. J-13.

PHYSICIST: Ph.D. 1927. Experienced in electric and magnetic measurements, testing and research. J-14.

PRECISION INSTRUMENT MAKER: 28 years experience on scientific and geophysical instruments. J-15.

RADIO ENGINEER: Graduate University of Illinois; 2½ years experience in radio set circuit and tube measurements as well as development, design and patent investigation work. J-16.

ELECTRICAL METER and INSTRUMENT MAN: Technical graduate, 8 years in instrument laboratory of electrical manufacturing company. J-17.

INSTRUMENT ENGINEER: 2 years university, 5 years public utility, 2 years sales and service large recording and controlling instrument manufacturer. J-18.

INSTRUMENT MAKER: Engineering and Drafting instruments, 20 years shop experience, Master Degree Guild of Nuremburg. J-19.

ELECTRICAL ENGINEER: Graduate Purdue University. Experience with Telephone and Telegraph circuits, industrial control methods and equipment, and electrical instrument testing and maintenance. J-20.

AIRCRAFT INSTRUMENT MAINTENANCE ENGINEER: Formerly Service Engineer for largest manufacturer of aircraft instruments. Especially familiar with airplane instrument problems. J-21.

CHEMIST: Graduate Hunter College 1918. Spent twelve years working out various chemical processes in the laboratory and demonstrating them from a practical standpoint in paper mills. Work in the laboratory has included water analyses, some bacteriological work, fibre examination and testing of various materials. J-22.

ADVERTISING MANAGER: Also assistant sales manager of flow meter manufacturing company. M.I.T. graduate Mechanical Engineer with 10 years shop, engineering, advertising and sales experience. J-23.

PHYSICIST: 2 years experience in research with particular training in atomics and electronics. Have held two fellowships. J-24.

COMMUNICATION ENGINEER: 10 years practical experience in installation, operation and maintenance of high frequency transmitters and receivers, also land line practice. Knowledge of Spanish. J-25.

ELECTRICAL ENGINEER: Experience with electric meter manufacturer and with an electrical testing laboratory. Master's degree in electrical engineering. J-26.

SALES ENGINEER: Sales promotion work on scientific instruments, industrial control, etc. Three years experience with manufacturer of scientific instruments and three years experience with manufacturer of automatic regulating devices. Graduate of University of Chicago. J-27.

ELECTRICAL ENGINEER: Graduate of University of Illinois with experience in development of control apparatus desires connection in research, design, or development of instruments or control apparatus. J-28.

SALES ENGINEER: B.S. degree, 1931, and graduate work in Physics and Chemistry, sales experience. Desires permanent connection with instrument manufacturer with opportunity to enter sales department. J-29.

MECHANICAL AND CHEMICAL ENGINEER: College graduate, experienced in general machine shop work, drafting. Three years as second assistant engineer in merchant marine. J-30.

SALES ENGINEER: Experienced in shop, service and sales. Interested in handling unit heat, ventilation and air conditioning apparatus. Licensed professional engineer. J-31.

METER SPECIALIST: 20 years experience with utilities and manufacturers. Meter, distribution and sales department. College education. J-32.

INSTRUMENT SALESMAN: Selling experience covers flow meters, CO_2 recorders; draft recorders and indicators; combustion and draft control; water and oil meters; electrical recording meters; watthour meters; testing devices and megohmers. J-33.

RESEARCH ENGINEER: Technical Director, Chemical Engineer, Research Chemist, expert in paper, oils, dyes, chemicals, fuels, augment and improve production, cut costs, sales service, patents, literary work, 6 languages. Trained Harvard and abroad. J-34.

MECHANICAL ENGINEER: 11 years experience in design, construction, sale, and servicing of power plant and industrial metering, regulating and control equipment. J-35.

AUTOMATIC MACHINE DESIGNER: 15 years designing experience on automatic machines including 5 years on boiler instruments, testing instruments and telegraph instruments. J-36.

INSTRUMENT ENGINEER: B.S. degree 1925; four years with precision electrical instrument company in the research department. Specialized in resistance coil manufacture and constant temperature baths. J-37.

PURCHASING AGENT: Experienced in purchasing materials for instrument manufacturers. Can systematize and fully qualified to take complete charge of department. J-39.

MEASUREMENT AND CONTROL SPECIALIST: Seeks connection with commercial laboratory, public utility or manufacturer, in capacity of developing engineer or consultant. Wide and extensive experience with all types of electrical instruments, both American and foreign, precision measurement, standardization and automatic control. Wide experience in patent work. Also adept in pyrometry and pneumatic control. Member A. I. E. E. J-40.

ELECTRICAL ENGINEER: 32, 3 years electrical metering and automatic control; 5 years laboratory and practical measurement of gas flow, furnace temperatures and gas analysis. Some sales experience. J-41.

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Sound and Vibration Devices and Applications (6.2)

Bouncing-Pin Versus Throttle-Audibility. NEIL MACCOULL. *S. A. E. Journal,* Aug. 1931, pages 137-138.

Experiments to determine if any difference in fuel matching by bouncing-pin or throttle-audibility on the same engine are described, also tests to determine if the Cooperative-Fuel-Research and Series-30 Ethyl Gasoline Corp. engines gave similar results for either method. To check these tests another study to find the relative precision of these two methods of knock testing was made. From these tests the conclusion is drawn that, with few exceptions, little difference could be detected in matching fuels on either the Ethyl Gasoline Corp., Series-30 or the Cooperative Fuel-Research engine. (6.2)

Effect of Sound Intensity on Knock Ratings. HARRY F. HUF, J. R. SABINA & J. BENNETT HILL. *S. A. E. Journal,* Aug. 1931, pages 134-136.

Measuring knock-sound intensity by a microphone and vacuum-tube amplifying set is described in this paper. Widely varying fuels are compared with mixtures of normal heptane and iso-octane at knock intensities ranging from incipient knock to a knock severe enough to cause preignition. The conclusion is drawn that, for tests on the L-head Cooperative Fuel-Research knock-testing engine, the intensity of knock at which tests are made does not affect the knock ratings if a fuel-matching method is used. (6.2)

A New Meter for Noise Analysis. T. G. CASTNER, E. DIETZE, G. T. STANTON & R. S. TUCKER. *Electrical Engineering,* Vol. 50, May 1931, pages 342-3.

The Bell System has developed a sound meter which consists of a sound-pick-up-device to convert acoustic into electrical energy, a multi-stage vacuum tube amplifier, a calibrated gain control to measure sound levels over a range of 90 db. (corresponding to a range of 1,000,000,000 to 1 in input powers). There is an electrical network to weight different frequencies in a manner similar to that in which they are weighted by the ear, a rectifier and visual indicating meter which responds in a manner similar to the ear, and means for over-all acoustic calibration. The sound meter is calibrated in terms of a 1000-cycle pressure of 0.001 dyne per sq. cm. in a free progressive wave which pressure is called the "reference sound level." Sound levels measured are expressed in decibels above this reference point. For a 1000-cycle tone, this reference level is somewhat above the minimum threshold of audibility of the average observer. The layout, calibration, and uses of the sound meter are discussed. W.H.B. (6.2)

Recent Machines for Vibration Testing. (Neuere Schwingungs-prüfmaschinen.) W. SPAETH. *Zeitschrift Verein deutscher Indenieure,* Vol. 75, Jan. 17, 1931, pages 83-85.

Vibration measuring apparatus exert on the body to be tested for vibrations artificial periodic forces for which the point of attack, direction of attack, magnitude, and frequency can be selected at will. The actions of these forces are recorded in resonance curves from which important characteristics, as f.i. natural frequency, logarithmic decrement of damping, magnification factor, swinging mass, dynamic spring constant, etc., can be determined numerically. A few of such machines for the investigation of bridges, soil and other purposes are briefly described. 9 references are cited. (6.2)

Dynamic Determination of the Load Coefficient of Soil with the Recent Vibration Agitator and the Vibration Meter "Geodyn." (Dynamische Ermittlung der Bettungziffer mit dem neuen Schwingungserreger und -messer "Geodyn.") P. MUELLER. *Zeitschrift des Oesterreichischen Ingenieur- & Architekten Vereins,* Vol. 83, Jan. 9, 1931, pages 5-6.

An instrument was developed with the object of quantitatively determining the elastic properties of soil with respect to the foundation of buildings. The "Geodyn," brought on the market by the Maihak A. G. Hamburg, represents an automatic recorder. The performance of measurements is demonstrated. EF (6.2)

Measurement of Vibration of Machines. F. SIEBER. *Archiv für Technisches Messen,* 1931, section V171-2, page T49.

From the measurement of the vibrations of machines or rotating parts or foundations conclusions can be drawn as to the mechanical stresses in the parts. An electro-vibrograph is described which consists mainly of two transformers with an air gap connected with primaries in series and secondaries in opposition; at rest the resulting voltage is therefore zero, but the air gap is changed by vibrations and the secondary voltages are changed. The small resulting currents are amplified and can then be used in known manner for indication or recording. Construction and method of measurement is described and a curve reproduced. Ha (6.2)

Three Component Vibrograph. AMERICAN ASKANIA CORPORATION. *Instruments,* Vol. 5, Jan. 1932, page 21.

This instrument was designed for the study of mechanical vibrations, particularly vibrations of structures. A special feature is that the vibrations are converted into visible wave forms by a mechanical-optical arrangement, rather than by use of an electrical oscillograph. HO (6.2)

Recording of Rapid Vibrations. (Aufzeichnen schneller-Schwingungen.) R. AMBRONN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Dec. 12, 1931, pages 1517-1518.

This instrument uses piezo-electric quartz plates which develop under the influence of variable pressure electric charges which are proportional to the pressures. The construction and calibration of such an instrument is described. Ha (6.2)

A Source of Mechanical Vibration for Experimental Purposes. F. AUGTIE. *Philosophical Magazine and Journal of Science,* Series 7, Vol. 11, Feb. supplement, 1931, pages 517-522.

A method is described to vibrate a loaded beam in a vertical plane which gave a controllable amplitude up to 0.002 inch at frequencies from 8 to 35 cycles per second with a good wave form. Apparatus used are described and curves of vibration reproduced. Ha (6.2)

General (12.1)

The Plant Instrument Department. ROY W. BROWN. *Instruments,* Vol. 5, Feb. 1932, pages 27-32.

Presents general background on the launching and conducting of a plant instrument department. Methods of selecting and organizing plant personnel and equipment are discussed at length. Also outlines systems and basic practices for instrument engineering, design, investigation and research activities of plant instrument department, choice of instrument construction, repair, and maintenance facilities; also their organization for efficient service. Outlined. Describes the development of a plant instrument exchange and how to conduct it to be of service to whole plant. HO (12.1)

The Laboratory Apparatus Industry in 1931. ARTHUR SCHNEIDER. *Instruments,* Vol. 5, Jan. 1932, page 14.

Mentions several new developments for metallurgy, calorimetry, chemical analysis. HO (12.1)

1931 Developments in Industrial Process Instruments. M. J. BÉHAR. *Instruments,* Vol. 5, Jan. 1932, pages 6-10.

A general review covering industrial measuring apparatus and control equipment in the fields of temperature, pressure, flow, humidity, speed, viscosity, etc. HO (12.1)

Chemical and Electrical Phenomena on Gas-Charged Metallic Surfaces. (Ueber chemische und elektrische Vorgänge an gasbeladenen Metalloberflächen.) R. SUHRMANN. *Zeitschrift anorganische und allgemeine Chemie,* Vol. 203, Dec. 30, 1931, pages 235-244.

The property of some metals to absorb certain gases to their surface to an extraordinary degree is discussed; the formula of Vander Waals does not hold good for all metals and gases, the author assumes therefore that electrostatic causes have to be used for an explanation. Metals are distinguished from other elements of the periodic system by the fact that they emit at sufficiently high temperatures glow electrons, and, at radiation with short-wave light, photoelectrons. The formula of Richardson permits calculating this emission. The adsorption of atoms whose valency-electrons are only loosely bound together and which are, when brought into contact with the surface of a metal with great electron affinity, is explained by the Einstein formula connecting the quantum energy with the electron velocity. Polarization and chemical border phenomena are closely related with adsorption. Ha (12.1)

Remote Measuring in Steel Mills. Part I. Principles of the Methods of Remote Measuring. (Fernmessen auf Eisenhüttenwerken. I. Die Grundzüge der Fernmessverfahren.) B. VON SOTHEN. *Archiv für Eisenhüttenwesen,* Vol. 5, July 1931, pages 17-28.

The paper deals with the principles and methods of remote measuring devices for the manifold applications in steel mills. GN (12.1)

Remote Measuring in Steel Mills. (Fernmessen auf Eisenhüttenwerken.) II. The Application of the Electric Remote Measuring Methods. (II. Die Anwendung der elektrischen Fernmessverfahren.) B. VON SOTHEN. *Archiv für Eisenhüttenwesen,* Vol. 5, Aug. 1931, pages 81-93.

Report 153 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. The paper deals with the application of the electric remote measuring methods in metallurgical plants, as blast furnace plant, the stoves, the open hearth plant, the rolling mills, the gas producer plant, and the Thomas steel plant. It further deals with the equipment for controlling heat, gas, water, compressed air and electric current. A detailed illustrated description is given of the various devices that are employed and suggested for the above purposes with special reference to the equipment as installed in the various plants of German steel mills. The paper concludes in pointing out the possibilities of development in the field of remote measuring devices. GN (12.1)

The Research Institute of the A. E. G. (Das Forschungsinstitut der A E G.) *Elecktrotechnische Zeitschrift,* Vol. 52, May 21, 1931, pages 672-673.

The new institute is a four-story building and contains physical, acoustic, electronic tube, electro-technical, chemical, insulation material and metallurgical-magnetic laboratories with library and necessary work shops. Ha (12.1)

Optical Coincidence Gage. I. C. GARDINER. *American Machinist,* Vol. 74, Jan. 22, 1931, pages 155-157.

Errors in measurement arise from the mechanical contact necessary in most gages. The U. S. Bureau of Standards has constructed one which replaces one or both mechanical contacts with an optical contact. Describes and illustrates this gage which with a single setting will measure within a plus or minus value of 0.00004 inches. RHP (12.1)

Measurement—The Key to Efficiency. F. C. KNOWLES. *Electrical Review,* Nov. 13, 1931, page 738.

Abstract of address of chairman of the Meter and Instrument Section of the Institution of Electrical Engineers, Nov. 6, 1931. Reviews some of the modern applications of instruments in industry, among these being remote automatic metering, functional signal transmission, KVA indicator, and measurement of resistance. MS (12.1)

Progress in Hydraulics. *Contributed by the Hydraulic Division of A. S. M. E. Mechanical Engineering,* Jan. 1931, pages 23-24.

This annual report of the Hydraulic Division of the A. S. M. E. makes several mentions of the increasing employment of instruments, particularly the application of Selsyn motors for remote indications, remote recording and remote control. The automatic operator is finding more extensive employment and various forms are continually coming on the market. MFB (12.1)

Concerning the Art of Metallography. FRANCIS F. LUCAS. *Heat Treating & Forging,* Vol. 17, July 1931, pages 668-671; Aug. 1931, pages 783-784, 813-814, 817.

The article describes the types and the function of instruments used and the results which may be obtained. The optical systems of the Abbe apertometer, microscope and testing objectives, the Zeiss-Martens metallurgical outfit, the methods of etching, taking of micrographs and "reading" of pictures are thoroughly explained. 8 references. Ha (12.1)

A Vacuum-Tube Device for Current-Balance Telemeters. B. F. Lenehan & Paul MacGahan. *Electrical Engineering*, Vol. 50, July 1931, Section I, pages 510-511.

This new device utilizes electron tubes for producing and controlling the feeble d. c. currents which constitute the indicating medium for this type of remote metering. The variations to be remotely observed are first translated into proportional currents, which are then transmitted over communication lines and measured at the remote receiving point by usual current measuring instruments. The only auxiliary power required can be obtained from an ordinary station-lighting circuit, and circuit constants are chosen so that momentary dips in this supply voltage do not affect the readings. WHB (12.1)

Remote Repeating and Summating. (of Meter Readings.) *The Instrument World*, Vol. 4, Dec. 1931, pages 147-148.

A system for remote metering developed by Trueb, Taeuber & Co., Switzerland, is described. Transmitter and receiver both have field coils across same line. Field coil induces in moving coil of transmitter an E. M. F. proportional to position of moving coil (i.e., to plane of moving coil and that of field flux). Receiver coil is tied together in series with transmitter coil, so receives a current from E. M. F. induced in transmitter coil which rotates it to same position as the latter. Receiver coil stops at that position, because E. M. F. induced in it by its own field then is equal and opposite to E. M. F. in transmitter coil. Advantages claimed: (a) Null method, independent of line resistance. (b) Null method, therefore can use several repeaters for each transmitter, without interaction between receivers. (c) By putting moving coil elements in series, can add indications, receive at a remote point the total of several meter readings. Circuits are given and applications described. HO (12.1)

A Special Planimeter for the Determination of Effective Values. (Ein Spezialplanimeter zur Bestimmung von Effektivwerten.) A. Adler. *Elektrotechnische Zeitschrift*, Vol. 52, Nov. 5, 1931, pages 1387-1388.

The instrument determines the effective value (where y is the ordinate, t time, and T period), by simply circumscribing the curve and its base line. Its principle is to carry out the squaring of the ordinates by a doubling of an angle. The theory of the simple instrument is derived and the construction described; the angle is doubled by an equilateral triangle. Ha (12.1)

Industrial Process Control. H. Olken. *Electronics*, Vol. 3, Oct. 1931, pages 144-145, 172.

The principle of using electrical oscillating circuits as means for controlling and measuring a product without contacting or disturbing it. An electric condenser is inserted in the circuit the plates of which are changed in their distance by irregularities of the product; this upsets the balance in the electric circuit and an ammeter in the latter indicates the irregularity; it is calibrated in the magnitude which is to be recorded, inches, pressure, etc. Ha (12.1)

The Automatisation of the Control of Coke-Oven Operation. (Zur Automatisierung der Kokreibetriebskontrolle.) L. Litinski. *Die Messtechnik*, Vol. 7, May 1931, page 117-130.

The modern automatic supervision of the operation of coke-ovens requires recording instruments for the coal charged into the ovens, process of distillations, operation of auxiliary machinery, amount of coke produced, measuring of the amount of coke-oven gases, temperatures of gases and cooling water, condensation, measurements in the power station and supervision of light-oil and benzol production. The arrangement and types, operation, as well as construction of such instruments is discussed in detail. A whole installation is illustrated on an example of American practice. Diagrammatic sketches of instruments and 38 references supplement the exhaustive paper. Ha 12.1)

Harmonic Analyzer. (L'analyseur harmonique Mader-Ott). J. Reyval. *Revue Générale de l'Electricité*, Vol. 30, Sept. 12, 1931, pages 413-419.

This instrument permits analyzing periodic curves; a mechanical operation gives the terms of the individual harmonics in the Fourier series. It consists in the combination of a planimeter with a system of levers and gears and is arranged so that the result can be read directly on a scale. To each harmonic corresponds a certain set of gears. The theory of the instrument is derived and the operation of it described and illustrated by an example. Ha (12.1)

Precision Measuring Instruments Used by the German Machinery Industry. O. P. van Steewen. *American Machinist*, Vol. 75, Oct. 22, 1931, pages 620-622; Oct. 29, 1931, pages 666-668; Nov. 5, 1931, pages 704-707.

To manufacture with greater economy two main expedients were used in Germany: 1, Systematic establishments of standards by the German Industrial Standardization Committee, and 2, enlistment of the optical industry for the purpose of cheapening and simplifying measuring method. The latter measure consisted in refining the inspection methods in order to exclude the personal factor and obtain closer tolerances. A great number of gages, microlasts, internal gages, gear testers, etc., are described and their function explained. (Ha 12.1)

Instruments for Practical Hydrometry. (Instrumentenkunde der praktischen Hydrometrie.) L. A. Ott.

This pamphlet of A. Ott, in Kenyston, Bavaria, deals with the principles of water measurements, giving briefly the theory and the most important points to be observed in carrying out the measurements. Hydrometric vanes in several types, the electric log for measurements in open water, vanes in pipe lines, continuous control of service, the construction of the instruments, electrical contacts, calibration, fields of application are fully described and the operation of each instrument explained. Ha (12.1)

Standardized Glass Apparatus in all Laboratories. (Genormte Glassgeräte in alle Laboratorien.) *Glass und Apparat*, Vol. 12, Aug. 23, 1931, page 131-134.

The magazine advocates strongly the general use of only standardized glass apparatus and points to the advantages derived by it. Series of beakers, dishes, etc. are described. Ha (12.1)

Development of the Wabblemeter for Measuring Bodily Steadiness as an Indication of Riding Comfort. F. A. Moss. *Soc. Automotive Engineers Journal*, Vol. 28, May 1931, p. 580-581.

Wabblemeters are instruments devised for the purpose of indicating ability to keep one's balance when placed on the instrument. The new instruments described here consist of a platform arrangement on which the subjects stand, loss of balance or unsteadiness is measured by the extent to which the platform is moved or wabbled, records being taken over a given unit of time. The movements of the platform are recorded automatically on two counters by a lever arrangement, and the machine integrates all the movements made when a person stands on the platform. Test results are described and standardization of the machine for certain variables suggested. Ha (12.2)

The Steadiness Meter and its Use in a Preliminary Investigation of Riding Qualities. Ammon Swope and G. C. Brandenburg. *Soc. Automotive Engineers Journal*, Vol. 28, May 1931, p. 582-583.

This instrument is designed for finding some objective means of measuring the nervous reaction of a subject under controlled conditions. It consists of a cabinet about 5 in. x 6 in. x 9 in. with a brass plate in the upper part having 21 holes from 3/4 in. to 1/8 in. in diameter; each hole is 1/32 in. smaller than the preceding one. The subject under test has to insert a stylus of 3/32 in. diameter without touching the brass plate successively into the holes, starting with the largest. The tests are described more in detail. Individual records reveal a significant relationship between total miles traveled and readings on the meter. Ha (12.2)

A Comparison of Mercurial and Aneroid Sphygmomanometers. Bradford Noyes, Jr. *Review Scientific Instruments*, Vol. 2, Oct. 1931, pages 632-637.

Tests are described which were to determine which kind of instruments was more suitable for the physician's use in measuring a person's blood pressure. It would appear that the indications of the mercury instrument lagged behind the true pressure on the arm bag of the sphygmomanometer; this lag may cause an error of as much as 45 mm. in the determination of systolic and diastolic pressures. In using a mercurial instrument the arm bag must be deflated at a rate slow enough to minimize this error. The principles of blood pressure measurement are set forth. Ha (12.2)

A New Apparatus for the Location of Cables. (Ein neuer Kabelsuchapparat.) Franz Kaiser. *Siemens-Zeitschrift*, Vol. 11, Oct. 1931, pages 470-472.

In order to determine the exact route of cables or one cable out of several running side by side, mostly one which has been disconnected for the purpose of repairs, the core of this cable is on one end connected to ground or the lead sheath, and on the other over a battery to ground. The ground current (return current) is therefore distributed over many paths while the core carries the full current. By placing an iron core with a coil and a galvanometer close to the cables the disconnected one will give the greatest deflection, while the others show a smaller deflection and also of reverse direction, as they carry only part of the return current. The apparatus as made by Siemens & Halske is described. Ha (12.2)

A Vernier Indexing Head. D. O. Dunstone. *American Machinist*, Vol. 74, Jan. 22, 1931, pages 168-169.

Describes and illustrates a device consisting of two disks, one with 16 holes and one with 15 holes. Combinations with these allow division of a circumference into 240 parts or any factor thereof. RHP (12.2)

Current Radiological Practice. E. H. W. Banner. *Electrical Review*, Dec. 11, 1931, pages 871-873.

Survey of apparatus and instruments shown at the exhibition of the British Institute of Radiology. MS (12.2)

A Method of Investigating the Reactions During the Setting of Cement. (Ueber ein neues Verfahren zur Untersuchung der Vorgaenge beim Abbinden des Zements.) A. Guttmann. *Tonindustrie Zeitung*, Vol. 55, Nov. 23, 1931, pages 1297-1299.

The paper presented at the Meeting of the Verein der Freunde des Kaiser Wilhelm Institut für Silikatforschung, Nov. 1931, pertains to the description and use of the "Mikroton" which eliminates the detrimental effect of water additions indispensable for the examination of setting cement under an ordinary microscope. The new equipment represents an optical study of cement samples embedded in paraffin. At certain intervals thin layers are cut off by a wedge and the small slices of 5 μ thickness are submitted to an examination at magnifications as high as $\times$ 1200. The phenomena occuring during the setting of cement are dealt with in the balance of the paper. EF (12.2)

Recording Automobile Tester. (Registrierendes Kraftwagen Prüfgernet.) D. P. Hoeffer. *Zeitschrift fur Instrumentenkunde*, Vol. 51, June 1931, pages 318-324.

The paper deals with an instrument recording the acceleration and braking ability of vehicles, particularly of automobiles. The timely operation of the brake, clutch, gear, and gas feeder is registered. The whole set is portable and includes a small storage battery and a clock mechanism. The recording system works electromagnetically and a pencil draws the curve on the travel-time-diagram. The various stages during the experiment are checked by contacts made by a specially designed auxiliary wheel the measuring range of which can be enlarged by a centrifugal switch. EF (12.2)

Investigation of Different Methods to Determine the Roughness of Metallic Surfaces. (Untersuchung verschiedener Methoden zur Bestimnung der Unebenheiten (Rauhigkeiten) von Metallflächen.) W. Kiesewitter. *Feinmechanik und Präzision*, Vol. 39, Dec. 1, 1931, pages 211-215.

A method of getting a perfect cast of a surface and an optical method to make visible and record the unevenness on it is described and illustrated by many examples. Ha (12.2)

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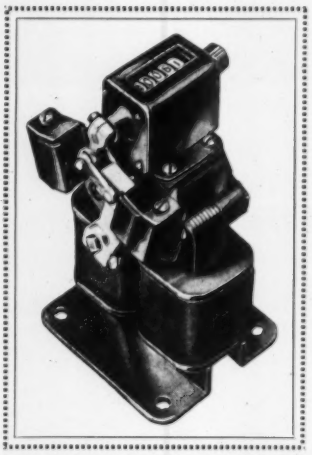

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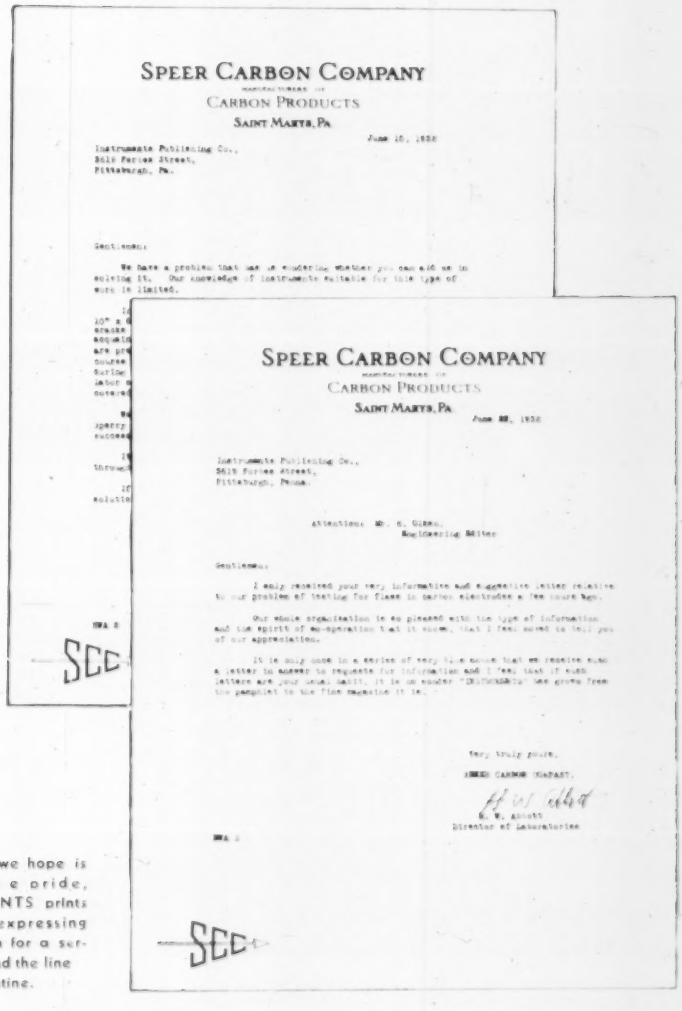
Beyond the Line of Routine

Every editor serves his readers—by collecting articles and information on the outstanding developments in the field covered by his publication, by collating data on certain subjects, by assembling the news, etc. But to editors of certain publications come opportunities to perform helpful acts outside the daily routine. INSTRUMENTS is such a publication.



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SAINT MARYS, PA.

June 18, 1938

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SAINT MARYS, PA.

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Engineering Editor

Gentlemen:

I only received your very informative and suggestive letter relative to our problem of testing for flaws in carbon electrodes a few hours ago.

Our whole organization is so pleased with the type of information and the spirit of co-operation that it seems, that I feel moved to tell you of our appreciation.

It is only once in a series of very, very few times that we receive such a letter in answer to requests for information and I feel that if such letters are your usual fault, it is no wonder [illegible] has grown from the pamphlet to the fine magazine it is.

Very truly yours,

SPEER CARBON COMPANY

H. W. Abbott

H. W. Abbott
Director of Laboratories

With what we hope is pardonable pride, INSTRUMENTS prints this letter expressing appreciation for a service beyond the line of routine.